Public Acceptance/Preference for Dairy Calf Housing Systems and Perceptions of Dairy Calf Welfare

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Abstract

The objective of the research reported in this thesis was to understand acceptance or preference of dairy calf housing options among the general public, adult and youth. Participants 18 years of age or greater (n = 1,310) and 5 – 17 years of age (n = 463) completed a survey at the Minnesota State Fair (St. Paul, MN, USA) in summer 2018. The survey presented three images of calf housing options (individual, pair, or group) and asked participants to indicate their acceptance of the housing option (adults) or select their preferred option (youth). Descriptive statistics of demographic data were obtained using the SURVEYFREQ Procedure of SAS (9.4). Rao-Scott Chi-Square test (PROC SURVEYFREQ, SAS 9.4) was used to investigate relationships between demographics and housing acceptance or preference, respectively. Content analysis was used for qualitative analysis with the goal of identifying perceptions, concerns, and values with respect to dairy calf welfare and reasoning underlying dairy calf house acceptance or preference. The median age range of adult participants was 45 – 54 years, 64.9% were female, 81.5% urban residents, 41.3% completed a Bachelor's degree, 94.0% owned a pet, 78.5% did not have a loved one who worked in the dairy industry, 80.7% did they have prior experience handling agricultural animals, and 62.9% had visited a farm in the past. For youth, the median age of participants was 11 yrs and 60.8% were female, 82.3% were urban residents, 89.6% owned a pet, and 62.6% did not have prior experience handling agricultural animals but 83.2% had visited a farm in the past. Overall, all participants were most accepting of the group housing option. For the adults, males, rural residents, and individuals with previous livestock handling experience were more accepting of the individual housing option. Group housing was most accepted due to the

calves' ability to socialize with other calves and space allowance. For youth, housing preference was not associated with age, gender, pet ownership, or prior visits to a farm. However, rural youth more frequently preferred individual housing compared to urban youth (13.6 ± 4.5% SE vs. 5.1 ± 1.3% SE, respectively) and urban youth more frequently preferred pair housing compared to rural youth (15.3 ± 2.2% SE vs. 6.8 ± 3.3% SE, respectively). Youth that preferred group housing most commonly referenced reasons of socialization and space allowance. These findings suggest that the public is more accepting of group housed dairy calves compared to individual or pair housed systems.

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Chapter 1

Literature Review

INTRODUCTION

Attitudes, beliefs, and values regarding the welfare of farm animals vary widely between people, cultures, and countries. Many studies have investigated public perceptions, values, and concerns of animal welfare (Vanhonacker et al., 2010; Weary et al., 2015b; Ventura et al., 2016; Li et al., 2018) but no research exists that focuses on the dairy calf. In recent decades, Western countries have experienced an increasing level of consumer consciousness about food safety risks, environmental effects of livestock production, and animal welfare issues (Hughes, 1997; Lai et al., 2018). Due to increasing ethical concerns surrounding farming methods, production systems are becoming a focus of public scrutiny and the public has become more skeptical of products on the market (Clark et al., 2016). Of many public concerns, the housing or farm animals is often the focus of criticism due to restricted movement and perceived lack of naturalness (Ellis et al., 2009; Ventura et al., 2016; Ventura and Croney, 2019).

Distrust and dissatisfaction in the livestock industries can cause public citizens to seek intervention from legislation. The public is powerful in their role as citizens and consumers, however, public concerns regarding animal welfare may be dismissed due to the assumption that the public is unaware of farming practices, therefore, they are less knowledgeable in care and husbandry needs (Ventura et al., 2016). Additionally, youth are commonly overlooked in their consumer power and their potential to heighten animal

welfare standards (Jamieson et al., 2015). Youth are future consumers, policy makers, parents, and stakeholders but little literature focusing on their perceptions of farm animal welfare exists (Muldoon et al., 2010; Jamieson et al., 2015). Hence, the problem being that although lay stakeholders are interested in animal welfare, more research is needed to determine their perceptions of dairy calf welfare and management practices. If the dairy industry can comprehend societal perceptions, values, and attitudes towards calf management and welfare, the industry can adopt management practices that are acceptable to the public. Two-way communication between industry stakeholders and public stakeholders will create a foundation to better resolve contentious farming issues (Ventura et al., 2016).

Previous research has taken an initiative to understand animal welfare oriented issues with the use of social science research methods such as the integration of qualitative research tools (Boogaard et al., 2011; Weible et al., 2014; Yunes et al., 2017). The research reported in this thesis employed a mixed method survey to collect data and recruit a large sample size. Our objective was to gain insight regarding attitudes toward dairy calf welfare and explore perceptions/acceptance for different calf housing systems.

LAY STAKEHOLDER VALUES

A lay stakeholder is a person of the general public who has no affiliation with the dairy industry (non-dairy farmer) or involvement with the production process but may nonetheless affect the industry by purchasing dairy or non-dairy products. In the current literature, a lay stakeholder is referred to as a citizen and consumer (Vanhonacker et al.,

2007; Ventura, 2015). Previous research has focused on consumers to determine their willingness-to-pay for animal products within market niches, including for animal welfare (Lagerkvist and Hess, 2011; Mulder and Zomer, 2017; Mancini et al., 2018). It has been suggested that a portion of the public chooses to purchase products they feel were produced with animal welfare in mind (Regmi and Gehlhar, 2001; Spain et al., 2018), which partially drives consumer preference for organic products (Harper and Makatouni, 2002a).

In contrast, the public that does not purchase dairy products and is unfamiliar with how food is produced also influences livestock agriculture production. Lay stakeholders that are not dairy product consumers are taking part in the acceptability of livestock farming around the globe (Busch and Spiller, 2018). Farms are experiencing high levels of social pressure including "active nongovernmental organizations (NGOs), undercover videos that are shot in stables, very critical media reports about contentious issues, public demonstrations against farming structures and practices, boycotts of firms, increasing legal requirements, and many more," (Busch and Spiller, 2018). Additionally, demand for livestock agriculture and production is heavily influenced by socio-cultural values and external pressures (Thornton, 2010). Research suggests that social and cultural drivers play a significant role in livestock production intensification and even though the role these drivers play in unclear, ethical concerns of animal welfare are increasingly attributing to these drivers (Thornton, 2010). The public's greatest concern with animal agriculture lies within animal hygiene and housing systems (von Keyserlingk and Weary, 2018; Clark et al., 2019).

The public is increasingly aware of animal welfare concerns due to media coverage, leaving the public to inquire assistance from policy makers (Vanhonacker and Verbeke, 2014; Weary et al., 2015a). Dissatisfying media coverage can leave long lasting psychological effects that can lead the recipient to become untrustworthy of the industry and seek intervention from legislation (Tiplady et al., 2013). These public concerns can be seen as a loss of trust in the industry and the government (Brom, 2000; Robbins et al., 2016). When the public feels that they are being ignored by their government and industry stakeholders they petition for stronger welfare standards (Coleman, 2018) and the industry faces losses to competing markets. We have seen in recent years that citizens have taken their voice to the voting polls. In previous elections, citizens have voted to ban housing practices in livestock production, such as gestation crates and battery cages (Tonsor et al., 2009b; Malone and Lusk, 2016). Most notable, California's Proposition 2 requires that,

> …[a] person shall not tether or confine any covered animal, on a farm, for all or the majority of any day, in a manner that prevents such animal from: (a) lying down, standing up, and fully extending his or her limbs; and (b) turning around freely (California Code, Health and Safety Code - HSC § 25990).

The greatest focus on understanding public perceptions of livestock welfare has taken place in Europe. Most notably, the 2016 Eurobarometer found that 94% of the public think protecting the welfare of farm animals is important, 82% think farm animals should be better protected than they are now, and 64% indicated that they would like to have

more information about the treatment of farm animals in their country (Eurobarometer, 2016). Additionally, in Europe, social concerns regarding animal welfare have already changed legislation. Governmental legislation has directly impacted producers and consumers, increasing prices of products to improve animal welfare (María, 2006). This proves that citizens have the power to influence the market and steer it in a particular direction and if they are ignored, the market will not be able to function (Brom, 2000). However, there is little reflection of public concern in the current legislature regarding the dairy industry's supply chain and market in the United States (Vanhonacker and Verbeke, 2014).

The surveys that have taken place in Europe and North America illustrate a similar representation of public concerns. In a survey carried out in Belgium, respondents found products that were associated with higher welfare standards to be healthier, safer, of better quality, and more trustworthy than the same type of product without welfare standards (Vanhonacker et al., 2010). Additionally, a subset of citizens that took part in the survey were invited to participate in a focus group. The citizens unanimously agreed that animal welfare was important but there was insufficient information available to the public on animal welfare standards when purchasing products at the store (Vanhonacker et al., 2010). Other studies have indicated that individuals perceive animal welfare-friendly products to have a greater regard for food safety (Cembalo et al., 2016). However, when making purchasing decisions, a European focus group felt that they lacked the knowledge necessary to make animal welfare conscious purchasing decisions (Miele, 2010).

The literature indicates that farm animal welfare is important to the public. The varying results of some studies could be due to the language of the questions or the role the survey participant is put into. For example, the studies that have found animal welfare to be of less importance than food safety and healthiness phrased the question framework to encompass purchasing decisions. The citizen and the consumer are separate roles and should be probed in different ways. Additionally, the respondents can have varying concerns depending on the industry in question. The Belgian study focused on pork and poultry systems and these European systems felt that poultry had a lower welfare standard than pork and beef systems (Verbeke and Viaene, 2000). In a series of surveys with North American animal science and veterinary faculty members, Heleski et al. (2006) found that faculty members were less concerned with dairy cattle production compared to meat birds and layers. In the sibling survey, Heleski et al. (2004) found 84% of animal science faculty agreed that the current methods of management provided appropriate levels of welfare to dairy cows. It appears to be that respondents are most concerned about animal welfare when natural behaviors are restricted. When online survey participants were asked to imagine their ideal dairy farm, in a Canadian survey, respondents focused largely on natural living (Weary et al., 2015a). The general public prefers that farm animals have behavioral freedom or naturalness while also having an element of tradition, even though they value the modernism of dairy production (Boogaard et al., 2010). Studies have shown that the public feels modern farming lacks tradition (Paarlberg, 2009) and there is a high reliance on antibiotics (Vanuga, 2018) which contests the publics' high desire for naturalness in the industrialized farm (Yunes

et al., 2017). Natural living has always been a concern to the public when asked about farming issues (Vanhonacker et al., 2007) with an emphasis on animals being allowed room to express natural behaviors (Lassen et al., 2006).

Citizens also feel that the farmers have become industrialized due to intensive market systems and farmers *"having to fight to survive*," (Vanhonacker et al., 2010). Similar to these findings, a qualitative research approach of frame-reflection was taken by a group of researchers in the Netherlands. The citizens that partook in this research explained that welfare on swine operations is hindered due to the operations being too large to account for animal welfare, that operations have morphed into unnatural environments, and that the goal of production is efficiency rather than animal welfare (Benard and de Cock Buning, 2013). The citizens had reached a consensus that their main concern was animal welfare but when posed with the question on what the solution could be made to make the farmer and society happy, they could not determine a solution that would fit both side's needs (Benard and de Cock Buning, 2013). In a telephone survey of United States households ($n > 1,000$), a relatively large proportion of respondents strongly agreed (29.3%) or somewhat agreed (19.9%) that animal welfare was an important factor for them when purchasing products (Prickett, 2008). Further, the same survey found that survey participants felt the well-being of animals to be strongly more (50.6%) or somewhat more important (26.4%) than low product prices (Prickett, 2008). A survey conducted in Ohio revealed that citizens expect farm animals to have a good quality of life; even though some are used for meat, farm animal welfare should be similar to that of pets, and farm animals should be protected from feeling pain (Rauch and Sharp, 2005).

In contrast, additional findings suggest that animal welfare is less important when compared to quality of the product, trustworthiness, health, and safety (Vanhonacker et al., 2010). In a consumer survey conducted in Iowa, Minnesota, and Wisconsin, consumers noted that pasture-raised beef and dairy products were important but this was due to perceived consumer health benefits and assumed humane treatment of the cows (Pirog, 2004). However, only 14% of the respondents found where beef and dairy cows were raised to be "very important" (Pirog, 2004). These studies make citizens think about their role as consumers versus societal members. In a similar survey of 320 meat consumers in Belgium, when asked to rank importance of attributes such as "healthiness", "leanness", "animal friendly production" and "free of harmful substances," 45% of respondents ranked "healthiness" as one of their top 5 attributes to choosing meat products and only a small group of participants ranked "animal friendly production" among their top 5 attributes when choosing a meat products (Verbeke and Viaene, 2000).

In a survey of United States household, only 15.6% of the public said they think low meat prices are more important than farm animal welfare but when they were asked to rank the general public, they strongly agreed or somewhat agreed (67.5%) that other Americans think low meat prices are more important than farm animal well-being (Lusk and Norwood, 2010). This study suggests that the great difference between the direct question and the indirect question is that indirect questions are a greater representation of the publics' true feelings; therefore, animal welfare is not as important to the public as activists groups make it seem (Lusk and Norwood, 2010). Of course, when making

inferences about the discrepancy between the responses there is room for misinterpretation of the results. The authors made emphasis of the desirability biases the people may choose to say well-being of farm animals is important to them because if they respond that farm animal well-being is not important this might be seen as inappropriate or socially unacceptable. Additionally, some individuals can greatly value animal welfare while they feel like their average peer has little interest in the quality of life animals live in livestock production.

Research also suggests that farmers attribute societal farming concerns to a lack of citizens' industrial knowledge (von Keyserlingk and Weary, 2018); however, the disconnect is also attributed to their varying values of animal welfare. One attempt producers make at addressing societal concerns is to restrict public access to production practices since it is assumed the public will not accept current practices due to lack of knowledge (Weary, 2018). In contrast, another attempt is agritourism as a means of educating the public so that they can comprehend and accept management practices. Agritourism is implemented with a goal that the guest will get a backstage view of farming and the producer can educate non-farming citizens on daily practices (Pearce, 1990) in an attempt to appear more transparent to the public (Dutkiewicz, 2018). However, agritourism has only been shown to have long lasting effects on brand recognition and little change in acceptance of farming issues (Barbieri et al., 2016). In a Canadian dairy tour by Ventura et al. (2016), it was suggested that societal concerns cannot be eradicated with one-way education efforts, rather, the industry and the public

should have a two-way communication path where the industry tries to comprehend contentious issues and makes conscious efforts to amend social concerns.

Studies have suggested that farmers and veterinarians tend to think of animal welfare from a biological functioning perspective of animal welfare while citizens tend to focus more heavily on natural living (Lassen et al., 2006; Sumner et al., 2018). Farmers tend to make decisions based on the production process so they have a more optimistic view of the current state of farm animal welfare while citizens view the current state of farm animal welfare as problematic when animals are not able to express natural behaviors in their current confined systems (Vanhonacker et al., 2008). Similarly, another study found that farmers feel they already provide a good level of welfare because they provide the animals with a satisfactory environment and humane care (Kauppinen et al., 2010).

Now that we have established that farm animal welfare is important to the public, we must determine what aspects of production need improvement in the eyes of the public. We must determine what constitutes good quality of life in the publics' eyes and how to accomplish naturalness in a confinement system. Although there is some research available on public perceptions of animal welfare, more research needs to be done in order to determine what management practices and housing systems are a concern to the public.

YOUTH STAKEHOLDER VALUES

There have been numerous studies that have investigated adult views and concerns of farm animal welfare (María, 2006; Vanhonacker et al., 2010; Eurobarometer, 2016), but relatively little research has focused on youth, perhaps because they are not perceived to have immediate consumer power (Jamieson et al., 2015). However, youth's perceptions of farm animal welfare are likely to impact their future decisions relative to purchase, consumption, and behaviors relative to farm animal welfare (Jamieson et al., 2015).

Youth have the potential to influence their family's purchasing dynamic through their attitudes (Sharma and Sonwaney, 2014). Youth attitudes stem in part from the education, affective experiences, cultural biases, and societal evaluations they experience regarding animals which shape the consumer choices that they make in the future (Rudman, 2012). Youth attitudes are also influenced by cognitive and environmental factors, which have also been identified in the consumer socialization process (Carlson et al., 1990), defined as the "process by which young people acquire skills, knowledge and attitudes relevant to their function as consumers in the market place" (Ward, 1974). Cognitive influences on purchasing decisions are usually related to age and environmental factors such as family, peers, and media (Sharma and Sonwaney, 2014).

It has been suggested that when children are involved in family dynamics, consumer decision making is twofold. Sharma and Sonwaney (2014) proposed a model in which children learn from parents on how to be consumers but parents also learn from children on how to make and change their opinions about different products. Food advertising has

even taken an interest in directing marketing toward American children because of their future consumer power and influence on parents (Story and French, 2004). Previous research has indicated that children learn about contentious food issues through a chain of communication from families and social networks (individual-level targets), schools and grocery stores (organizational-level targets), and media and local legislation (community-level targets) (Pelletier and Kraak, 1998). Other studies have taken a more sociological approach by incorporating the Theory of Integrated Behavior to understand purchasing decisions of young adults. For example, a study in Belgium found that sustainable dairy purchasing decisions are influenced by personal attitudes, availability, perceived social influence, and perceived consumer effectiveness (Vermeir and Verbeke, 2008).

Relatively little research focuses on youth attitudes to animal welfare, and limited studies focus on farm animals specifically. Such research that does exist has often focused on how education can impact animal welfare standards. Abeyesinghe et al. (2012) found that knowledge gained from an animal welfare education event for children was only temporary but that there was a relationship between knowledge acquisition and behavioral intention. In an Edinburgh study, researchers hypothesized that instilling positive animal care values to children via education should have a positive effect on morals and be advantageous for human wellbeing (Muldoon et al., 2010). Results indicated that childhood pet ownership is an important factor in instilling animal wellbeing and interest in animals, but it seems to decline with age (Muldoon et al., 2010). Another stud implemented animal welfare curriculum in Mexican schools to assess animal-related knowledge (Aguirre and Orihuela, 2010) and determined that certain

demographic characteristics, such as area of residency and rural exposure to farming animals, may play a role in youth attitudes to animals.

In adults, interest in animal welfare is known to relate to many demographic factors including gender, age, and pet ownership. For example, females are thought to have a greater concern for animal welfare and animal rights, which may stem from dietary choices and pet ownership (Phillips et al., 2011). Additionally, adult females generally score higher on pro-animal welfare attitudes and animal caretaking (Herzog, 2007). Studies have also explored the relationship between age and attitudes toward animals, finding that children 6 to 9 years old have a greater emotional attachment to animals, while 10 to 13 year olds have greater knowledge of animals, and 13 to 16 year olds possess greater ethical and ecological concerns toward animals (Kellert, 2011). Similar studies have indicated that pet preference, ownership, attachment, and attitudes has connections between moral attitudes, such as empathy, and future human-animal relationships (Daly and Morton, 2006). Additionally, studies have shown childhood pet ownership can lead to more positive attitudes among youth and better knowledge of non-companion animals (Prokop and Tunnicliffe, 2010). Also, prior research suggest that young, less educated, and non-Caucasian women experiencing financial hardships tend to have a greater regard for animal well-being (Kendall et al., 2006).

Given the potential for youth to influence their parents, and because of their own future consumer power, it is important to continue exploration of youth attitudes toward animals, especially as relates to farm animal welfare. However, to date there has been

relatively little, if any, research to explore youth attitudes to farm animal welfare in the United States, and to our knowledge, no studies specific to the dairy industry or dairy calves.

DAIRY CALF MANAGEMENT

Public views on management and housing of dairy calves have not been extensively researched. The way dairy calves are housed differs from other domesticated species. In most species of farmed animals, newborns and young are housed with their dam before weaning. However, dairy calves are typically separated from their dam within the first few hours after birth (Costa et al., 2016). In addition, for the past 50 years, the majority of dairy calves have been housed individually in hutches to minimize disease transmission (Krawczel, 2016). In the 2014 NAHMS (USDA, 2016) survey, 70% of dairy producers reported housing calves in individual hutches, while 15% reported group rearing of calves. In a natural setting, the calf would remain with the dam until approximately 10 months of age when the calf is fully weaned, maintaining the maternal bond and social contact throughout development (Costa et al., 2016). When calves are housed in individual hutches, they possess little opportunity to socialize with other calves.

When calves are given social opportunities, they socialize as early as 2 days old (Duve and Jensen, 2012) and are highly motivated to physically access other calves (Holm et al., 2002). Calves form bonds between herd mates at 3.5 months of age and these bonds are beneficial for routine comfort in farming practices (Raussi et al., 2010). Calves form bonds between peers through allogrooming behavior and play. Allogrooming is a form of

social behavior in cattle that has been defined as one cow licking another cow's body surfaces, except anal regions (Wood, 1977). Social allogrooming allows calves to form and maintain social bonds (Sato et al., 1993). Similarly, play behavior has been shown to be a positive indicator of animal welfare and help create bonds within the herd (Babu et al., 2004)

Depriving calves of social contact can have a host of negative effects. Calves housed individually at a young age are found to be more fearful and distressed when introduced to a group setting (Bøe and Færevik, 2003). Other research has determined that fearfulness in calves can lead to pessimistic personality traits (Lecorps et al., 2018). In contrast, calves that are housed in groups are more socially confident and are less likely to show aggression towards other calves (Bøe and Færevik, 2003). There is evidence that calves find social support in peers when housed in a group setting. In a study that assessed milk weaning among individual and group housed calves, dairy calves housed with a companion were less likely to vocalize during weaning (De Paula Vieira et al., 2010). Additionally, dairy calves in a novel arena setting were less likely to vocalize when introduced to the environment with a companion, indicating that calves find comfort in conspecifics (Færevik et al., 2006).

Isolation in dairy calves has also been shown to affect their cognitive abilities. For example, individually-housed calves perform more poorly in reversal learning tasks than do pair-housed calves, suggesting limitations in learning capacity (Gaillard et al., 2014). Other studies have indicated that calves housed in isolation have a difficult time coping

with novel stimuli and develop self-directed coping behaviors, such as sucking (Veissier et al., 1997). Studies have investigated a furnished hutch to reduce behavioral and growth challenges of individually reared calves, yet there is no evidence to support that stationary stimuli can produce the same behavioral effects on the calf that socialization creates (Pempek et al., 2017).

Aside from the dairy calf, individual calf hutches are known to be labor intensive for farm workers (Krawczel, 2016). For farms that want to experiment with group housing but lack resources to build a new facility, pair housing options may be attractive (Wormsbecher et al., 2017). Pair housing increases social opportunity and space allowance while having no adverse effects on health and weight gain due to competition (Chua et al., 2002). More generally, housing calves with companions can improve solid feed intake (Keil and Langhans, 2001) and increase weight gains after weaning (Warnick et al., 2010). While some evidence suggests that cross sucking is hard to manage in a group setting (Lidfors and Isberg, 2003), others indicate that this can be reduced if calves are fed ad libitum milk and with an artificial teat (Chua et al., 2002).

A common concern with group housing of calves is increased morbidity and mortality. The most commonly referenced characteristic of individual calf housing is that it limits social contact, therefore reducing enteric and respiratory disease that can be spread via physical contact (McGuirk, 2008). Some studies support this claim (Gulliksen et al., 2009a), while others have found no evidence to suggest that individual housing sufficiently reduces disease compared to housing in small groups (Waltner-Toews et al.,

1986). Group size appears to be important in disease management of calves, as research has indicated associations between large group size and increased mortality rate of dairy calves (Gulliksen et al., 2009b). However, a US study concluded that if group size is kept under 7 calves, no difference in calf mortality was detected between individually housed calves and small group housed calves (Losinger and Heinrichs, 1997). Another study found reduced rates of diarrhea and respiratory disease in calves housed in groups compared to individually housed calves (Babu et al., 2009). Additionally, diarrhea in pre-weaned dairy calves and daily growth were found not to be associated with group size and feeding of pasteurized milk (Reiten et al., 2019). There appear to be ways to further improve calf health in group systems, for example by providing additional bedding, increased rest and thus improved growth (Hänninen et al., 2005).

In summary, the literature suggests that group housing of calves can promote both calf health and calf behavior. Together with research suggesting that the public wishes to see livestock animals living a more natural lifestyle, we hypothesized that the public would prefer group over individual systems, though no research is currently available to confirm this hypothesis.

SOCIAL SCIENCE AND ANIMAL WELFARE

Recently, effort has been made to determine public attitudes and behaviors toward animal welfare. In the United States both ‘hard’ and ‘soft’ sciences (quantitative and qualitative approaches) are merging to shape meat and livestock industries (Tonsor, 2018). Quantitative research uses numbers as data, collecting both discrete and continuous

variables, and analyses these data using statistical techniques (Braun and Clarke, 2013). In contrast, qualitative research uses words as data, collecting both nominal and ordinal variables, analyzing data in a multitude of different methods (Braun and Clarke, 2013). Mixed method research is the combination of quantitative and qualitative approaches to data collection and analysis. A mixed method research approach is often small qualitative research which means methods of data collection are within a positivist or essentialist paradigm (Kidder and Fine, 1987). Essentialism is "the idea that events result from fixed qualities 'inside' people or "essences" and positivism is the "theoretical framework more making sense of the world which assumes a world that exists independent of our ways of getting to know it, and that if we observe it properly, we can discover the reality of the world" (Braun and Clarke, 2013). A common approach to mixed method research is the use of qualitative survey tools.

Historically, survey research was entirely paper-based via mail or fax (Cobanoglu et al., 2001) but with technology being more available, surveys have taken a new web-based format. Some benefits of online survey research include: quick and easy distribution, highest level of anonymity and relatively cost effective (Andrews et al., 2003; Braun and Clarke, 2013). However, like all research methods there are cons to online qualitative survey formats which include: requiring computer skills and there is the risk of excluding marginalized groups (Braun and Clarke, 2013). When considering survey design, it is imperative to consider sample size as a determinant of power and access to subjects (Glasow, 2005); however, there is no simple answer for the sample size (Sandelowski, 1995). When considering sample size things to consider include: available resources,

time restraints, the purpose of the research, and what information is necessary to answer the research question (Patton, 2002). Depending on the research question of the survey, chosen analysis, richness of data, and contribution of participants, recommended survey sample size is between 15 and over 100 participants (Braun and Clarke, 2013). For a small qualitative survey that has few open-ended questions, it is ideal to aim for a sample size larger than 100 participants (Braun and Clarke, 2013). Additionally, it is critical to consider how much data are needed before saturation is reached. Saturation is the concept that refers to surplus data failing to uncover new information (Braun and Clarke, 2013).

In survey design, the wording of questions needs to avoid bias language and context (Glasow, 2005). Survey language should use wording that is consistent with the desired participants' education level (McIntyre, 1999). Next, the types of survey questions offered are a critical piece in determining the depth of data gained. In a mixed method survey, providing participants with more close-ended questions (quantitative) and fewer open-ended questions (qualitative) can generate large amounts of data and be less daunting to a sample of interest compared to interviews or focus groups (Braun and Clarke, 2013). Providing qualitative methods in research design is "useful for obtaining insight into regular or problematic experiences and the meaning attached to these experiences of selected individuals and groups, which, under certain conditions can achieve understanding," (Leech and Onwuegbuzie, 2007).

In animal science, research groups have taken social science approaches to understand varying stakeholder beliefs, attitudes, and values. However, research by Kristensen and

Jakobsen (2011) suggests that there is a lack of consistency in terminology of theories which describe the same phenomena. Because of this, it is critical to define distinguished models of social psychology literature which are highly referenced in both qualitative and quantitative research. Early theories regarding behavior and attitudes considered trade-offs between personal and environmental factors of behavior (Wallace et al., 2005). The Theory of Reasoned Action stated that behavioral actions are a function of (1) attitude toward a behavior and (2) subjective norm (Fishbein and Ajzen, 1975). Ajzen refined the Theory of Reasoned Action to include (3) perceived behavioral control (Ajzen, 1991). The attitude toward the behavior refers to how favorable or useful the individual finds the attitude object that is being considered while also taking into account the beliefs about the behavior. Additionally, values are an essential component of attitude and belief formation (Ajzen, 2001) and values are the "criteria people use to select and justify actions and to evaluate people and events" (Schwartz, 1999). Subjective norm refers to perceived social pressure the individual feels in order to perform or not to perform the behavior. Finally, perceived behavioral control refers to the ease or difficulty of performing the behavior, which is assumed to take into account past experiences. The Theory of Planned Behavior offers fundamental framework in predicting and explaining individual's behaviors and intentions. Recently, the Theory of Reasoned Action and Theory of Planned Behavior have been expanded into the Integrated Behavioral Model which includes components from other major theories (Montaño, 2016). All three models emphasize that the most important determinant of behavior is intention to perform the behavior (Fishbein and Ajzen, 1975; Ajzen, 1991; Montaño, 2016).

Some research efforts have explored the relationship between attitudes and behaviors as it pertains to animal welfare. Studies have linked attitudes and beliefs of livestock handlers with their behavior toward animals (Hemsworth et al., 2002), management decision and productivity (Kauppinen et al., 2013), reproductive efficiency (Hemsworth et al., 1994), and other animal welfare indicators (Ceballos et al., 2018; Destrez et al., 2018). Additionally, studies have found that attitudes and behaviors toward animals can be affected by gender, companionship, and knowledge (Hills, 1983; Paul and Serpell, 1993). Other research suggests that attitudes and behaviors are influenced by social norm aspects, such as political and social views (Jamison and Lunch, 1992). Also, studies have suggested that occupation can predict attitudes toward animal welfare (Ostović et al., 2016). Animal welfare can be defined using different assessment criteria such as the Five Freedoms (Farm Animal Welfare Council,1993), Five Domains (Mellor and Beausoleil, 2015), and Three Spheres (Fraser et al., 1997). The research reported in this thesis used the Three Spheres of Animal Welfare framework (Fraser et al., 1997) to organize and conceptualize the data. The three distinct aspects of animal welfare include: biological functioning (physical condition and health), natural living (the degree to which an animal can live a natural life), and affective state (how an animal feels). This framework incorporates diverse values that people find necessary for an animal to have good welfare while also encompassing established definitions of animal welfare (Broom, 1991; Duncan, 1993; Rollin, 1993).

SUMMARY

Previous research has focused on societal concerns within the dairy industry such as pain management (Robbins et al., 2015), cow-calf bond (Meagher et al., 2019), pasture access (Kühl et al., 2019), and veal management (Pardon et al., 2014), yet no peer reviewed literature is available regarding public and especially youth perceptions of dairy calf housing and welfare. Traditionally, dairy calves have been housed in individual hutches to reduce transmission of disease but research has shown that calves reared in isolation are more fearful and are deficient in reversal learning (Gaillard et al., 2014; Lecorps et al., 2018). In contrast, housing calves in small groups can confer numerous behavioral and cognitive benefits without compromising health (Losinger and Heinrichs, 1997; Babu et al., 2009; Costa et al., 2016) . Thus, it is important to investigate ways to support and encourage the dairy industry in making transitions to social housing of dairy calves.

It is essential for industry stakeholders to comprehend public voices because lay stakeholders impact livestock production through consumer purchasing decisions, legislation, and interpersonal relationships. If the industry ignores public concerns and perceptions, risks include compromising social sustainability and long-term viability. If the industry can hear public concerns and adapt to them, it will strengthen its image as a committed industry and gain consumer satisfaction (Brom, 2000; Ventura et al., 2016).

Additional research is yet needed to better understand perceptions, values, and concerns of animal welfare as it pertains to the dairy calf, starting with calf housing because it has profound impacts on calf welfare and because public criticism of agriculture often

focuses on the housing system. Therefore, it is important to investigate adult perceptions of dairy calf housing since public views of dairy calf management are under explored. Additionally, youth stakeholders are the future of the livestock industry so gaining their insight on dairy calf welfare perceptions would be just as advantageous.

Therefore, the objective of this thesis is to examine public, both adult and youth, perceptions and attitudes toward dairy calf welfare and to explore youth preference and adult acceptance for different calf housing options and reasons underlying preference/acceptance. Such information will allow dairy industry stakeholders to understand public concerns and values, enabling them to adopt calf housing options that incorporate socialization opportunities and greater space allocation for their calves. This study can be used as a reference for the dairy industry on more socially acceptable calf housing practices.

Chapter 2

Youth perceptions of dairy calf welfare and preferences for dairy calf housing options

SUMMARY

Public perception of farming systems is a critical component of social sustainability. While research on public attitudes to various aspects of dairy farming exists, youth perspectives in this area have been underexplored. The objective of this study was to identify attitudes about dairy calf welfare and preferences for dairy calf housing options among youth. Participants 5 to 17 years of age (n = 463) completed a 21-item in-person survey at the Minnesota State Fair (St. Paul, MN, USA) in summer 2018. The survey was administered via Qualtrics using iPads and, in addition to collecting demographics and open-ended questions on dairy calf welfare, presented three images of calf housing options (individual, pair, or group) and asked participants to select their preferred option and indicate their reasoning for selection. Descriptive statistics of demographic data were obtained using the SURVEYFREQ Procedure of SAS (9.4). Rao-Scott Chi-Square test (PROC SURVEYFREQ, SAS 9.4) was used to investigate relationships between demographics and housing preference. Content analysis was used for qualitative analysis with the goal of identifying perceptions, concerns, and values with respect to dairy calf welfare and reasoning underlying dairy calf house preference. The median age of participants was 11 yrs and 60.8% were female, 82.3% were urban residents, 89.6% owned a pet, and 62.6% did not have prior experience handling agricultural animals but

83.2% had visited a farm in the past. Participants considered biological functioning (82.1% of responses), natural living (44.3%), and humane care (30.2%) to be necessary elements for a calf to have a 'good' life. Overall, group housing was overwhelmingly preferred (80.1%), followed by pair (14.3%) and individual housing (5.6%). The most common reasons youth preferred group housing was due to socialization (71.4%) and space allowance (58.5%). Housing preference was not associated with age, gender, pet ownership, or prior visits to a farm. However, rural youth more frequently preferred individual housing compared to urban youth (13.6 ± 4.5% SE vs. 5.1 ± 1.3% SE, respectively) and urban youth more frequently preferred pair housing compared to rural youth (15.3 ± 2.2% SE vs. 6.8 ± 3.3% SE, respectively). Youth that preferred individual housing most commonly referenced reasons of environmental quality (access to food and/or water, housing setup, or perceived housing safety with limited other detail) (38.5%), optics (26.9%), and individual health attention (19.2%). Youth that preferred pair housing most commonly referenced reasons of socialization (31.8%), compromise between housing systems (28.8%), and environmental quality (24.2%). These findings suggest that youth from urban backgrounds may be less accepting of individual housing systems for dairy calves and that group housing is preferred by majority of survey participants.

INTRODUCTION

In recent years, attempts have been made to understand the public's views, concerns, and perceptions about farm animal welfare (Weary et al., 2015a; McKendree et al., 2016; Busch et al., 2017). As the public's interest about animal welfare increases, society

preferences are expected to exert increasing influence on production practices in livestock agriculture (Vanhonacker et al., 2007). Farm animal welfare standards can be influenced by consumer purchases of animal products such as meat, milk, or eggs (Regmi and Gehlhar, 2001). The public's concern in animal welfare can influence more than purchasing decision. Recently, numerous states in the USA have banned certain housing practices through voter-driven referenda (Mench, 2008) because of livestock housing concerns. It is crucial for the dairy industry to understand public perception in order to make current management practices more acceptable to the public and build trust with the public as a transparent, committed industry (Schweikhardt and Browne, 2001).

Many research efforts have taken an approach to understand contentious issues within the public to create awareness among producers. Practices such as dairy cow-calf separation (Ventura et al., 2013), pasture access (Spooner et al., 2014) and painful procedures, such as dehorning (Robbins et al., 2015), have been emerging as contentious issues. Among the studies that have been published globally, there are limited data on public attitudes toward calf management.

In regard to calf management, the dairy industry has routinely housed calves individually (NAHMS-USDA, 2016), which enables farmers to manage each calf's health and nutrition, but recently some producers have started housing calves in pairs or groups. Housing calves in pairs or groups allows calves to have social interactions while also partaking in natural play behaviors (Babu et al., 2004). Studies have shown that calves housed in groups have improved solid feed intake during the preweaning stage (Keil and

Langhans, 2001) and greater weight gain after weaning (Warnick et al., 2010). In contract, housing calves individually has shown to lead to difficulties coping with novel situations and subordinate social skills that are problematic later in life (Costa et al., 2016).

In addition to the lack of knowledge available on public perceptions of dairy calf welfare, there is no peer-reviewed data available on youth perceptions of dairy calf housing practices. In a recent European study (Jamieson et al. 2015), adolescents perceived dairy cattle to have the best welfare in comparison to broiler chickens and pigs. Youth stakeholders are often overlooked in their power as industry drivers even though they are future policy makers and consumers (Jamieson et al., 2015). It is beneficial for the dairy industry to understand societal preferences in order to improve their image and demonstrate their commitment to public concerns. Therefore, the objective of this study was to investigate dairy calf welfare attitudes and dairy calf housing system preferences among youth.

MATERIALS and METHODS

A mixed-method survey was used to investigate dairy calf welfare values and dairy calf housing preferences and underlying reasons among youth attending the 2018 Minnesota State Fair in St. Paul, Minnesota. The survey instrument was approved by the University of Minnesota's Institutional Review Board under protocol #STUDY00003443. The Minnesota State Fair has an attendance of approximately 2 million people. Participants were recruited at the University of Minnesota Driven to Discover Research Facility over

five 7-h shifts between August 25 and September 2, 2018. We used convenience sampling for this study and state fair attendees were eligible to participate in the study if they were between 5 and 17 years of age (per self-report), able to read and write in English, and obtained consent from a parent or guardian. The anonymous survey was administered via iPads and the data were collected and managed using Qualtrics survey software (Qualtrics, Provo, UT). Participants received a small drawstring backpack or a cow-shaped stress-ball upon completion of the survey as an incentive to participate.

Survey Description

For the duration of the survey, parents/guardians could visibly see their children, however, researchers asked parents to not help children with the survey instrument. If children needed clarification or help completing the survey, they were instructed to consult the research team. The survey consisted of 17 multiple choice questions and 2 open-ended questions. Demographic data (Table 1) were collected on age, gender, area of residency, prior experience handling agricultural animals, prior experience visiting a farm, having a loved one who works in the dairy industry, and pet ownership. For the analysis of associations between age and housing preference, we created age categories (making age a categorical value) of 5 – 11 years and 12 – 17 years in addition to using age as continuous variable. Participants were given open to select "*I don't want to say*," for gender, prior experience handling agricultural animals, prior experience visiting a farm, having a loved one who works in the dairy industry, and pet ownership. We then asked participants to indicate whether they had visited dairy related locations at the Fair (e.g., the "Moo Booth", CHS Miracle of Birth Center, Cattle Barn, Dairy Building) and if

they used social media platforms (Facebook, Twitter, Instagram, Snapchat). Participants were also asked if they consumed dairy and plant-based alternative products.

Participants were then prompted to share their views of dairy calf welfare by responding to the mandatory open-ended question, "What does a dairy calf need to have a good life?" Participants had to type their response using the touch-screen keyboard on the iPad. The open-ended question about what a dairy calf needs to have a 'good' life was followed by a series of questions to rank importance of the following elements to a good life on a Likert scale ranging from "not important" [1] to "very important" [5] (e.g. right amount of food, water, shelter, and doctor care; ability to play with other calves; and be treated calmly and respectfully by their owner). Participants were then shown 3 pictures of calf housing systems (one each): individual (Figure 1), pair (Figure 2), or group (Figure 3) and asked to choose their preferred housing option and answer a mandatory open-ended question on their reasoning behind their choice. Pictures were chosen to be as consistent as possible in terms of environmental factors (all indoors, similar lighting, similar housing material, limited background available, similar flooring, food and water sources available in each picture, etc.). Participants could only choose one of the three options.

Statistical Analysis

Quantitative analysis.

For descriptive statistics (Lewis, 2017), PROC SURVEYFREQ (SAS 9.4, Cary, Indiana) was used to estimate the totals and proportions of all distinct values of categorical (gender, area of residency, previous experience working with agricultural animals,

previous experience visiting a farm, if the participant has a loved one in the dairy industry, previous pet ownership, prior experience visiting cattle-related locations at the State Fair, prior experience with social media platforms, dairy and plant-based alternative consumption habits) and continuous values (age). Rao-Scott Chi-Square test (PROC SURVEYFREQ, SAS 9.4) was used to investigate relationships between demographics (age and age category, gender, area of residency, previous experience working with agricultural animals, previous experience visiting a farm, if the participant has a loved one who worked in the dairy industry, previous pet ownership, prior experience visiting cattle related locations at the State Fair, prior experience with social media platforms, dairy consumption habits, and plant-based alternative consumption habits) and housing preference (Lewis, 2017). *P*-values < 0.05 were considered statistically significant.

Qualitative analysis.

Content analysis was used for the qualitative responses (open-ended questions). The first stage of this process consisted of thoroughly reading, re-reading, and coding all text from the responses for emerging patterns (Coffey and Atkinson, 1994). I coded all responses independently and then discussed the preliminary codes with my co-authors. Once all authors agreed upon preliminary codes throughout the data, a finalized codebook was created using recurring patterns and perceptions, concerns, and values with respect to dairy calf welfare. The codebook consists of codes which highlight the similarities between participant's responses. Content analysis was used for the question about what a calf needs to have a 'good' life and reasoning behind housing preference, but separate codebooks were created for each question. Example responses that demonstrate themes

are quoted below, followed by participant number in brackets (e.g. [P11] to designate Participant #11).

For analysis of the open-ended question about what a calf needs to have a 'good' life, Fraser et al.'s description of animal welfare in terms of 1) biological functioning (e.g. physical condition and health), 2) natural living (the degree to which an animal can live a natural life), and 3) affective state (how an animal feels) was used as a starting framework for the code list (Fraser et al., 1997), but the final coding scheme was expanded beyond this framework based on participants' responses. The theme "humane care" was also integrated into the starting framework for coding based on Ventura et al. (2016)'s findings that public values for dairy animal welfare go beyond these three descriptions.

For analysis of reasoning behind housing preference, themes were created to encompass all responses by participants and provide a more detailed understanding behind participant housing preference. Themes that were used include: *being alone, compromise between housing systems*, *environmental quality*, *health*, *individual health attention*, *optics, socialization, miscellaneous,* and *space allowance*. Particularly vague responses from which no further meaning could be gleaned (i.e. *"it has what it needs,"* [P50]) were identified and coded in initial stages and then excluded from further analysis.

RESULTS

Description of Participants

A total of 463 participants completed the survey and were included in analysis (see Table 1 for participant demographics). However, 129 responses were not collected in response to gender and 130 responses were not collected in response to area of residency so total of participants was 334 and 333, respectively, for analysis of those particular demographics. Median age of participants was 11 years, 60.8% were female, 82.3% had lived most of their lives in urban or suburban settings, 62.6% had not worked with or handled farm animals, 83.2% had visited a farm with animals, 75.6% participants did not have a loved one who worked in the dairy industry 89.6% had owned a pet in the past or currently owned a pet, 76.2% had visited at least one State Fair location that pertained to cattle, 56.8% used a social media platform, 94.4% indicated that they consumed dairy products such as milk, cheese, yogurt, butter or ice-cream, and 47.1% indicated that they consumed plant-based dairy alternatives such as almond beverage, soy beverage, or other plant-based beverages. For the two age categories of 5 – 11 years and 12 – 17 years, the number of participants was 235 and 228, respectively.

Calf Welfare-Specific Perceptions and Values

Quantitative responses.

An overwhelming majority of participants indicated that the right amount of food, water, shelter and doctor care, along with being treated calmly and respectfully, were important (98.9% and 97.8%, respectively). However, a smaller proportion of respondents (70.6%) felt that the ability to play with other calves was important for good calf welfare.

Qualitative responses.

Following completion of the Likert scale section that pertained to overall calf welfare, participants entered into the qualitative portion of the survey. Participants' written responses on what dairy calves need to have a 'good' life were coded based on the criteria discussed by Fraser et al. (1997) and Ventura et al. (2016). Elements related to biological functioning were most commonly mentioned by participants (82.1% of responses), followed by natural living (44.3%), humane care (30.2%), and affective state (5.0%). These elements were defined from the following animal welfare value criteria:

1. Biological functioning: calves described as needing elements related to nutrition, shelter, promotion of physical health and avoidance of illness, physical safety and hygiene, e.g. *"water, a healthy diet, shelter to protect them from the weather and predators"* [P25] and *"good environment with clean bedding"* [P465].

2. Natural living: Participants articulated elements of natural living. These elements include pasture access, space allowance to carry out natural behaviors like play or *"exercise"* [P51] or reference to outdoor elements such as sunshine, fresh air, or natural foods like *"plants"* [P433]. For example: *"A calf needs to have a pasture of grass for it and its friends/brothers/sisters to get fresh air"* [P371].

3. Affective State: focused on the animal's mental well-being and included references to happiness, comfort, *"leisure time"* [P231], *"psychological care"* [P310], and absence of stress and loneliness. For example: *"[S]he needs to have fun like any other living species"* [P206].

4. Humane care: emphasized the care and attention provided by humans, with participants mentioning that calves need a *"good caregiver"* [P1], routine training, regular grooming, and an overwhelming majority of participants said that a calf needs *"love"* [P11]. For example, *"it needs a good home and owners…once it grows up it needs to be carefully treated so it doesn't get hurt while being milked, it always needs to be cared for"* [P190].

Most participants included more than one animal welfare value in their responses, with a median value of 1.62 values (range: 0 to 4). For example, the comment *"love, food, water, happiness, room to roam, comfortable living environment"* [P359] references values for *biological functioning* (food, water, comfortable living environment), *natural living* (room to roam), *affective state* (happiness), and *humane care* (love).

Relationship Between Demographics and Calf Housing Preference

Overall, group housing was overwhelmingly preferred (80.1%), followed by pair (14.3%) and individual housing (5.6%) (Figure 4). No relationship was found between calf housing option and any of the collected demographics, with the following exception: area of residency (Figure 5). Area of residency was associated with a preference for individual

calf housing ($P = 0.026$); rural youth more frequently preferred individual calf housing compared to urban/suburban youth (13.6 ± 4.5% SE vs. 5.1 ± 1.3% SE). Area of residency was also associated with a preference for pair calf housing ($P = 0.021$); urban youth more frequently preferred pair housing compared to rural youth (15.3 ± 2.2% SE vs. 6.8 ± 3.3% SE).

Reasons for Calf Housing Preferences

All themes presented for each housing option can be found on Table 3. Similar to responses to the question about what calves need for a good life, participants often included more than one theme in their response. A total of 5 themes were identified in participants' reasons for selecting individual calf housing as their preferred option (in decreasing order of frequency): *environmental quality*, *optics*, *individual health attention*, *being alone*, and *miscellaneous*. A total of 7 themes were identified in responses by participants who selected pair housing as their preference. The themes were (in decreasing order of frequency): *socialization*, *compromise between housing systems*, *environmental quality*, *affective state*, *space allowance*, *optics, and miscellaneous*. A total of 6 themes were identified in participant responses in support of group housing (in descending order of frequency): *socialization*, *space allowance*, *environmental quality*, *feelings*, *optics*, and *health*.

Individual Housing.

Only 5.6% of participants chose individual calf housing as their preferred housing method (n = 26).

The most common theme (mentioned by 38.5% of participants) was *environmental quality* for reasons supporting individual housing as the preferred choice. This theme made reference to the housing setup with limited other details, made reference to food and/or water, organization or perceived safety of the housing (e.g. *"it is [a] suitable living area"* [P52] and *"they have [their] crates"* [P267]). Additionally, 26.9% of participants preferred individual housing due to *optics*, or the way the housing setup looked to them (e.g. *"it looks calm"* [P432] and *"because it looks cute"* [P434]).

Both *individual health attention* and *being alone* were each mentioned by 19.2% of participants who preferred individual calf housing. *Individual health attention* was mentioned by participants as an effective way for the producer to manage calves' health and nutrition on an individual basis: for example, *"limiting contact prevents spreading [of] germs and you can keep a better profile on them if one won't drink, [if one is] sick, etc."* [P465] and *"if one needs a change in diet, it is easy to fix. If one needs more care, it can be easily taken care of,"* [P341]. *Being alone* was mentioned by respondents who appeared to prefer calves having their own private space, away from other calves, e.g., *"they are secluded"* [P446]. This theme was in contrast to themes raised by participants choosing pair or group housing, who preferred calves to *not* be alone (see below).

Finally, only 7.7% of participants who chose individual housing as their preferred option did so for *miscellaneous* reasons. A select number of participants raised themes not well-captured by the common reasons, including feelings of the calf and referencing their (the

participant's) past experience with calf husbandry. The calf's feelings were mentioned by a participant that stated that they preferred individual calf housing *"because it has only one [calf] and there are no other [calves]…they are not emotionally attached to each other. If they were emotionally attached, they would be sad when one is taken away,"* [P229] (which was also coded as *being alone*). There was only 1 participant that preferred individual calf housing due to previous experience.

Pair Housing.

Only 14.3% of participants chose pair housing as their preferred calf housing method (n = 66).

Participants preferring pair housing most commonly mentioned *socialization* (31.8% of participants in this preference) and provided some description of the system as allowing play or interaction between calves, or calves needing a friend or companion. For example, participants said that they preferred pair housing "*because he had a friend"* [P455] and *"so they can play around"* [P317].

Another common theme was *compromise between the other two systems* which was mentioned by 28.8% of participants who preferred pair housing. For example, participants mentioned: *"[it] is not super crowded but it isn't isolated either"* [P331], *"too many in one enclosure might be too problematic and one calf alone might be too lonely"* [P276], and *"fewer calves in one area [means they get] more individual attention"* [P418].

Similar to participants who preferred individual housing, 24.2% of those who selected pair housing also mentioned themes related to *environmental quality*, for example supporting their selection because pair housing had *"plenty of food and water [for the calves]"* [P337] and simply, *"good living conditions"* [P316].

Participants (19.7%) also stated that they preferred pair housing due to *affective state*, for example that pair housing allowed avoidance of negative feelings related to stress or loneliness (i.e. *"not lonely"* [P335] and *"they shouldn't be alone because they get depressed"* [P436]).

Space allowance was commonly mentioned (16.7%) by participants who chose pair housing, for example *"[the calves] have a good [amount of] space for the both of them"* [P149] and *"it was just the right size"* [P354]. Additionally, the theme of *optics* was also used by pair housing supporters, e.g. that this option *"looked the best"* [P280] and *"because it's the cutest"* [P355].

Finally, only one participant who chose pair housing as their preferred option did so for *miscellaneous* reasons. A participant raised themes not well-captured by the common reasons, including perception of easier calf management saying, "*because there are two calves, so you don't have to do that much work,"* [P143].

Group housing.

A majority of total participants (80.1%) chose group housing as their preferred calf housing option.

As with pair housing, those who chose group housing most commonly (71.4%) used the theme of *socialization*, referencing multiple calves in the pen or positive interaction between calves (e.g. *"the calves can play and socialize which is important to all animals"* [P8], *"because they…can learn from each other and also they form bonds"* [P36], and *"because they can play with friends"* [P153]).

Those who preferred group housing also commonly referenced *space allowance* (58.5% of participants in this preference) provided by this system (*"it had a lot of space compared to the other ones"* [P427],) or referenced individual locomotive behaviors that are possible only through increased space (*"more space to run around"* [P24], and *"the dairy calf has more room to roam freely"* [P35]).

Similar to individual and pair housing systems, 11.6% of those who preferred group housing referenced elements related to housing or *environmental quality.* There were 20.9% of participants that referenced environmental quality that specifically mentioned the group housing option was less cage-like, e.g. *"it looked more humane and less prison-like"* [P130].

Less commonly, participants who preferred group housing referenced *affective state* (5.4%, e.g. "*because [there is more] than one calf [so it] is not lonely, when they are together it makes them feel at home"* [P71]), *optics* (3.0%, e.g.*"[it] looked the nicest"* [P330].), and *miscellaneous* reasons (0.8%).

DISCUSSION

To our knowledge, no other study to date has examined youth perceptions, values, and preferences for dairy calf welfare and housing options. The current study explored how a large sample of diverse, youth citizens perceived dairy calf housing and welfare.

Farm Animal Welfare Concerns and Values

Farm animal welfare is an increasingly contentious topic in Western countries (Clark et al., 2016). The public has already taken an active role in livestock decisions by banning livestock housing options through voter-driven referenda (Mench, 2008). Additionally, food animal product demand is affected consumers' concern for animal welfare (Regmi and Gehlhar, 2001). Although much of the literature on public values/preferences for animal welfare focus on adults (Abeyesinghe et al., 2012; Jamieson et al., 2015), there is existing data suggesting that youth are a critical part of family purchasing dynamics (Sharma and Sonwaney, 2014). Therefore, it is important to investigate their housing preference because their perception of the dairy industry can affect parent's decisions.

When participants were probed on the importance of biological functioning to a dairy calf's welfare, 98.9% of participants believed that the right amount of food, water,

shelter, and doctor care was important. Although less commonly referenced in their reasoning to support housing types, elements related to biological functioning were also commonly raised by participants who preferred individual (65.4% of these participants using the themes of *individual health attention* and *environmental quality),* pair (60.6% of these participants using the theme of *environmental quality* and *compromise between housing systems*) and group housing for dairy calves (11.6% of these participants using themes of *environmental quality*). Perhaps some factors related to biological functioning, like access to food, water, and doctor care, were less frequent in response because most participants assumed that all calves had equal access to those resources since we did make an attempt to ensure basic qualities were consistent throughout the three pictures.

A majority of participants that preferred pair or group housing in the current study indicated that behavioral freedom and allocation of space was important for good calf welfare in their preference to calf housing, a finding that supports previous research that identified that adolescents find it important that animals are provided with adequate space and behavioral freedom (Abeyesinghe et al., 2012; Jamieson et al., 2015). This finding aligns with previous data that the public places a high priority on natural living in order for farm animals to live a good life (Harper and Makatouni, 2002b; Spooner et al., 2014; Ventura et al., 2016). *Space allowance* and *socialization* were not themes that were mentioned by the 5.6% of participants that chose individual calf housing as their preferred housing option.

Regarding affective state, this area of animal welfare was less prominent in discussion when participants were asked to identify attributes that are necessary for a calf to have a good quality of life. The lack of references to affective state of the calf could be due to our framing of the questions, which may have primed participants to think about external stimuli rather than the calf's internal affective state (Ventura et al., 2016). However, when participants were probed on the importance of being treated calmly and respectfully by its owner and the ability to play with other calves, an overwhelming majority (97.9% and 70.6%, respectively) rated these aspects as "important" for calf welfare. Affective state was also a common theme to support housing preference, used by 23.1% of participants who chose individual calf housing (themes: *affective state* and *being alone*), 19.7% of participants who preferred pair housing and 5.4% of participants that preferred group housing.

With regards to values related to humane care, a little over a quarter of all participants found calf welfare to be interwoven with the attitudes and actions of their human caretakers and almost all participants (97.9%) agreed that it is important for a dairy calf to be treated calmly and respectfully by its owner to have a good quality of life. However, human-related responses were less frequent in responses to preference for housing option. Only 23.1% of participants mentioned human-related reasons for preferring individual calf housing (theme: *individual health attention* and *miscellaneous*) and 30.3% of participants brought up similar topics for preferring pair housing (themes: *compromise between housing systems* and *miscellaneous*). Participants that preferred group housing did not mention any human-related responses in their reasoning. Other studies have found

similar results that the public finds humane care, gentle handling, and farmer-animal interaction to be an important contribution to the quality of life of the animal (Spooner et al., 2014; Weary et al., 2015a). Even though human caretakers directly affect all 3 spheres of animal welfare, it is important to point out that this was a distinct theme articulated by participants as separate from other aspects of calf care.

Demographic Influence on Preferences for Calf Housing

The present results suggest a relationship between youths' urban/rural residency and a preference for individual and pair calf housing (Figure 5). Rural youth more frequently preferred individual calf housing compared to urban and suburban youth. Additionally, urban youth more frequently preferred pair housing compared to rural youth. Previous research suggests that individuals with a rural background and who are closer to farm production would have greater awareness of farming issues (Harper and Makatouni, 2002b). The results of the current study are consistent with other studies that indicate area of residency and associations with animal welfare attitude differences (Serpell, 2005; Herzog, 2007). However, other research indicates that effects of residency are not always established or in the expected direction (Kendall et al., 2006). Previous research suggests that the prior experience farming resulted in difference of animal welfare views instead of living environment (Vanhonacker et al., 2007). In the current study, we did not find an association with prior livestock handling experience or prior farm visit experience which could be due to our framing of the question since we asked participants if they "worked with" or "handled" farm animals in the past. The phrasing of the question could have been misleading to participants.

Previous research has found that females have greater empathy and concern for farmed animals' welfare compared to males (Phillips et al., 2011; Jamieson et al., 2015). On average, women show higher concern for animal use and feel that they should be protectors of animals while men, on average, have been found to possess less favorable attitudes toward animal protection, partake in hunting, and are more likely to abuse animals than women (Herzog, 2007). The current study did not find associations between gender and housing preference.

Additionally, previous research has found that younger and middle aged people had more animal-centered opinions than older people (María, 2006), finding that people under the age of 20 had higher willingness to pay for animal friendly products and were more critical in their purchases of animal-derived clothing products. Our study did not find associations between individual age groups (as a continuous variable) or age categories and housing choice; however, the oldest participants in our survey were 17 years old. Research by Roedder (2002) suggests that children make different purchase decisions in the self-centered stage (2 – 6 years), preoperational stage (7 – 11 years), and operational stage (7 – 11 years). We decided to combine the self-centered stage and preoperational stage in analysis because we did not have a large enough sample of children to keep the self-centered stage children separate, due to our inclusion criteria of children needing to be able to read in order to participate in the study.

Current or childhood pet ownership has been shown to be related to more positive attitudes towards companion animals and non-companion animals in previous research (Paul and Serpell, 1993; Daly and Morton, 2006; Prokop and Tunnicliffe, 2010). Owning a pet has been found to strengthen the human-animal interaction and instill characteristics such as empathy and greater attachment to animals (Daly and Morton, 2006). Additionally, pet ownership has been shown to shift dietary choices (e.g. vegetarianism or veganism) and involvement with animal welfare and environmental organizations (Paul and Serpell, 1993). Similar studies indicated that children that had household pets were more knowledgeable on contentious animal issues (Prokop and Tunnicliffe, 2010). Our study did not find an association between pet ownership and housing preference which could be attributed to our small sample size of participants that did not own a pet (10.2%) compared to participants that did own a pet (89.8%).

Exposure to animal welfare topics can also contribute to the knowledge used by children to make animal-based decisions (Aguirre and Orihuela, 2010). Although we did not directly assess knowledge about farming or dairy cattle-related topics, we asked participants if they had visited cattle-related State Fair locations prior to taking our survey or had previously visited a farm, with the assumption that prior visits might be associated with underlying concern for animal welfare. However, we did not find associations between housing preference and prior visits to farms or fair locations. We also hypothesized that if youth participants had a loved one in the dairy industry, they would have underlying knowledge of dairy management practices that would be associated with calf housing preference, but we did not find any associations among

youth. It is possible that our sample of participants that had a loved one who worked in the dairy industry was too small (15.6% of participants) to detect statistical significance compared to participants that did not have a loved one who worked in the dairy industry (84.4%).

Finally, we examined social media use and potential relationships with housing preference. Previous research has indicated that social media can affect demand of certain animal products (Tonsor and Olynk, 2011), with beef being less affected than pork or poultry. The public is increasingly exposed to animal agriculture, including undercover activist videos exposing abusive practices, via an increasingly broad range of media (Tiplady et al., 2013). This exposure can leave psychological footprints with the recipient and negatively impact public perception of the livestock industries indefinitely (Tonsor et al., 2009a). No associations were found in the current study between calf housing preference and social media use as a whole, suggesting that youth might not be exposed to animal husbandry issues like adults or their social media presence is less prominent compared to adults. To test this theory, we could have asked participants to indicate amount of time spent on social media per week and investigated if time spent on social media had associations with housing preference.

CONCLUSIONS

To our knowledge, this is the first study to explore perceptions, values, and preferences for animal welfare among American youth in the context of the dairy calf. The youth

surveyed overwhelmingly preferred group housing, followed by pair, then individual housing of dairy calves. Youth most commonly preferred group housing because of perceptions related to increased space allowance and opportunity for the calves to socialize, suggesting that public's desire for natural living in dairy farming may start at an early age. The implication is that the dairy industry should consider adopting calf housing options that incorporate socialization opportunities and greater space allocation for their calves. This study can be used as a reference for the industry to implement more accepted housing options in commercial systems.

Chapter 3

Public perceptions of dairy calf welfare and acceptance for dairy calf housing options

SUMMARY

The objective of this study was to explore values and perceptions of dairy calf welfare and acceptance of dairy calf housing options among the public. Participants 18 years old or greater (n = 1,310) were invited to complete a 26-item survey at the Minnesota State Fair (St. Paul, MN, USA) in summer 2018. The survey was administered via Qualtrics using iPads and, in addition to collecting demographics, presented three images of calf housing options (individual, pair, or group) and asked participants to rank their acceptance for each option and indicate their reasoning for selection. Descriptive statistics of demographic data were obtained using the SURVEYFREQ Procedure of SAS (9.4). Rao-Scott Chi-Square test (PROC SURVEYFREQ, SAS 9.4) was used to investigate relationships between demographics and housing acceptance. Qualitative content analysis was used for housing acceptance responses and themes were assigned to reoccurring perceptions and values of dairy calf welfare. Median age range of participants was 45 – 54 years, 64.9% were female, 81.5% urban residents, 41.3% completed a Bachelor's degree, 94.0% owned a pet, 78.5% did not have a loved one who worked in the dairy industry, 80.7% did they have prior experience handling agricultural animals, and 62.9% had visited a farm in the past. Overall, participants were most accepting of the group housing option. Males, rural residents, and individuals with previous livestock handling experience were more accepting of the individual housing

option. Group housing was most accepted due to the calves' ability to socialize with other calves and space allowance.

INTRODUCTION

Agricultural production has focused mainly on food safety and efficiency, but today's consumers expect their products to have greater regard for the welfare of the animals (Blokhuis, 2008). In a demand-driven economy, consumers play a large role in food production practices (Vanhonacker et al., 2007; Weible et al., 2014). The public has already taken a role in livestock production through banned housing practices due to voter-driven referenda and a motivation for enhanced farm animal welfare (Mench, 2008; Yunes et al., 2017). Therefore, time is of the essence for the dairy industry to comprehend stakeholder concerns so as to be able to adapt and maintain trust as an industry committed to upholding public confidence (Schweikhardt and Browne, 2001; McKendree et al., 2016).

There has been some research on public perception of dairy cattle welfare in Europe, Canada, and South America, with many particularly focused on specific, contentious issues, e.g. , pasture access (Spooner et al., 2014), and painful procedures, such as dehorning (Weary et al., 2015a). However, there are relatively limited peer-reviewed data on how Americans view and perceive dairy cattle welfare (Tonsor and Olynk, 2011; Robbins et al., 2015; McKendree et al., 2016). Moreover, to our knowledge few data are available on public attitudes toward management of the heifer dairy calf, with the

possible exception of cow-calf separation (Ventura et al., 2013; Busch et al., 2017; Cardoso et al., 2017).

Dairy producers have widely utilized calf hutches to reduce transmission of disease among dairy calves and to eliminate the occurrence of cross-suckling (Krawczel, 2016). However, some producers have taken an approach to house calves socially. Housing calves in pairs or groups gives calves the opportunity to socialize and partake in natural behaviors, such as allogrooming (Sato et al., 1993) and play (Babu et al., 2004), improved solid feed intake during the preweaning stage (Keil and Langhans, 2001), and greater weight gain after weaning (Warnick et al., 2010). It has also been noted that calves have a high desire to access social contact with other calves (Holm et al., 2002) and that early isolation of dairy calves induces deficiencies in social skills, difficulties in coping with novel situations, and deficient learning abilities (Costa et al., 2016). Individual calf housing is inadequate for the psychological and behavioral needs of the dairy calf and little research has been conducted on the citizen and consumers attitudes toward this management option.

Therefore, the objective of this study was to identify public values for the welfare of the dairy calf and to explore public acceptance of different calf housing options and reasons underlying acceptance.

MATERIALS and METHODS

A mixed-method survey was used to identify dairy calf welfare values and acceptance of dairy calf housing and underlying reasons among adults 18 years old and greater who attended the Minnesota State Fair in St. Paul, Minnesota. The current study was approved by the University of Minnesota's Institutional Review Board (#STUDY00003443). The Minnesota State Fair is one of the largest state fairs in the United States, attracting 2-million visitors annually. Participants were recruited at the University of Minnesota Driven to Discover Research Facility over five 7-h shifts between August 25 and September 2, 2018. The current study utilized convenience sampling and the only inclusion criteria was that the participant be above the age of 18 years, able to read and write in English, and able to provide verbal or written consent. The survey was hosted on Qualtrics survey software (Qualtrics, Provo, UT) and administered via iPads. Participants received a cow-shaped stress-ball or drawstring backpack upon completion of the survey. All participants provided consent prior to initiating the anonymous survey.

Survey Description

The survey consisted of 24 multiple choice questions and 1 mandatory, open-ended question. Demographic data (Table 4) were collected on age range, gender, highest level of education completed, household income range, area of residency, prior experience handling agricultural animals, prior experience visiting a farm, having a loved one who worked in the dairy, and pet ownership. Participants had the option of opting out of answering questions about their age, gender, education, income, and area of residency. We then asked the participant if they had visited certain dairy cattle related locations at

the Fair (e.g., the “Moo Booth”, CHS Miracle of Birth Center, Cattle Barn, Dairy Building) and if they used social media platforms (Facebook, Twitter, Instagram, Snapchat). Participants were also asked if they consumed dairy products, organic dairy products, and plant-based alternative products.

Participants were then required to respond the open-ended question, “Think of the dairy calf: a calf, unlike a human, starts walking within minutes after birth,” then followed with “consider the dairy calf: in your opinion, what do dairy calves need to have a good quality of life?”, followed by series of questions to rank importance of the following elements to a good life on a Likert scale ranging from “not important” [1] to “very important” [5] (e.g. adequate food, water shelter, and veterinary care; opportunity to socialize with other calves (within a week after birth) and play with other calves; and be treated and calmly by caretaker to avoid causing fear and distress). For the next questions, participants were given a statement that said, “for the following questions we will show you three types of calf housing, the types of housing influence two aspects: the farmer’s ability to manage calves’ health and nutrition and the calf’s opportunity to socialize with other calves.” A brief context of the housing practice was included to control for probable varying knowledge and in keeping with the general tradeoffs perceived between the systems. Then participants were shown a picture of three dairy calf housing options each separately and in a randomized order. For individual calf housing (Figure 1) participants were given the statement, “these dairy calves are housed individually, which enables farmers to manage each calf’s health and nutrition; calves can see and hear other calves but have no physical contact”. For pair housed calves

(Figure 2) participants were given the statement, “these dairy calves are housed in pairs, which could pose some challenges for managing health and nutrition; calves can freely socialize with each other”. For group housed calves (Figure 3) participants were given the statement, “these dairy calves are housed in small groups, which could pose challenges for monitoring health; calves can freely socialize with individuals in the group”. All housing options were followed with, “please indicate your agreement with the following statement: “this housing option is acceptable to me.” Participants were provided with a Likert scale ranging from “strongly disagree” [1] to “strongly agree” [5] and given an optional open-ended space to explain their choice. The pictures were chosen with the intent that they were as consistent as possible in terms of other environmental factors (all indoors, similar lighting, similar housing material, similar amount of exposed hardware, limited background available, similar flooring, food and water sources available in each picture, etc.).

Statistical Analysis

Quantitative Analysis.

For descriptive statistics (Lewis, 2017), PROC SURVEYFREQ (SAS 9.4, Cary, Indiana) was used to estimate the totals and proportions of all distinct values of categorical (gender, age range, income range, education, area of residency, previous experience working with agricultural animals, previous experience visiting a farm, having a loved one in the industry, previous pet ownership, previous experience visiting cattle related locations at the State Fair, participant’s social media platform usage, dairy consumption habits, and plant-based alternative consumption habits) variables. Rao-Scott Chi-Square

test (PROC SURVEYFREQ, SAS 9.4) was used to investigate relationships between demographics (gender, age range, education, income range, area of residency, previous experience working with agricultural animals, previous experience visiting a farm, having a loved one in the industry, previous pet ownership, previous experience visiting cattle related locations at the State Fair, participant's social media platform usage, dairy consumption habits, and plant-based alternative consumption habits) and housing acceptance (individual, pair, or group) (Lewis, 2017). Likert scale was collapsed into three categories (agree, neutral, disagree) (Jeong and Lee, 2016) and treated as a discrete variable (Allen and Seaman, 2007) based on sample size and application of Likert scale questions. *P*-values < 0.05 were considered statistically significant.

Qualitative Analysis.

We utilized content analysis for the qualitative portion of the survey (open-ended questions). The first stage of the analysis required that each group member read, re-read, and code responses to detect emerging patterns (Braun and Clarke, 2013). I coded all responses independently and preliminary codes were discussed with co-authors. Once all authors agreed upon preliminary codes throughout the data, all authors collaborated in designing a codebook that defined sets of data to predetermined codes. This stage was crucial in detecting recurring patterns of participant perceptions, concerns, and values. The codebook was used for highlighting similarities between participant's responses. Content analysis was used for the open-ended question that asked participants what they thought a calf needed to have a 'good' life and responses that explained housing acceptance, but separate code books were created for each section. Responses that

demonstrate themes are quoted below, following by participant number in brackets (e.g. [P26] to designate Participant #26).

For the coding process about what a calf needs to have a 'good' life, Fraser et al.'s (1997) description of animal welfare was utilized. Fraser et al.'s three spheres include: biological functioning (e.g. physical condition and health), natural living (the degree to which an animal can live a natural life), and affective state (how an animal feels) which was used as a baseline to organize data. However, participants' responses branched beyond the framework and included "humane care" based on Ventura et al.'s (2016) animal welfare-specific perceptions, concerns, and values.

For analysis of optional reasoning behind housing acceptance, themes were created to group reoccurring patterns of data by participants. Themes included: *conditional acceptance*, *compromise between housing systems*, *environmental quality*, *individual health attention*, *lack of socialization*, *ease of management*, *management concerns*, *optics*, *previous experience*, *socialization*, *space allowance*, *visual/auditory interaction*, and *unnaturalness*. Particularly vague responses from which no further meaning could be extrapolated (i.e. *"this housing option is acceptable to me"* [P773]) were identified and coded in initial stages and then excluded from further analysis.

RESULTS

Description of Participants

A total of 1,310 participants completed the survey and were included in the analysis (Table 4 shows participant demographics). Of these participants, 64.9% participants were female, the median age range was 45 – 54 years, 41.3% of participants completed a Bachelor's degree, 81.5% had lived most of their lives in urban setting, and the median household income was $80,000 - $89,999. More than half of participants had not worked with or handled farm animals (80.7%), but 62.9% had visited a farm with animals. Of these participants, 78.5% did not have a loved one who worked in the dairy industry and 94.0% had owned a pet in the past or currently own a pet. More than half had visited at least one State Fair location that pertained to cattle (89.2%), 83.5% used a social media platform, 93.7% indicated that they enjoyed eating or drinking dairy products like milk, cheese, yogurt, butter or ice-cream, and 52.9% indicated that they do not eat or drink any dairy-like products (almond beverage, soy beverage, or other plant-based beverages).

Calf Welfare-Specific Perceptions and Values

Quantitative responses.

In the calf welfare portion of the survey (Table 5), a majority of participants indicated that adequate amount of food, water, shelter, and doctor care, being treated calmly and respectfully, and ability to play with other calves were at least *important* for overall calf welfare (98.5, 95.1, and 85.4% respectively).

Qualitative responses.

Participants raised five general themes in their responses to what dairy calves need for a good life, in descending order of frequency:

1. *Biological functioning* (69.5% of respondents) emphasized physical condition of the animal and overall health (e.g. food, water, shelter, hygiene, and safety). For example, participants wrote that calves needed: *"food, shelter, warmth, and water"* [P155], *"dry barn and clean bedding"* [P1321], and *"a safe farm that they are fed proper supplements at"* [P474].

2. *Natural living* (49.6%) emphasized the calf's ability to live a natural lifestyle. Participant responses included references to *"fresh air, fresh grass, space to move, sunlight"* [P292] or *"open pasture"* [P420], and more specific references to *"friends and family"* [P980], especially *"siblings and parents"* [P220]. This category also includes participants' specific reference to calves being able to carry out natural behaviors, including *"social interactions and exercise"* [P1179] and *"playtime"* [P352].

3. *Humane care* (20.2%) focused on the care and attention provided by humans, with most participants specifically mentioning that calves need *"love"* [P213], *"caring farm hands"* [P327] and *"compassionate farmers"* [P658].

4. *Affective state* (4.7%) emphasized the animal's mental health and included references to promotion of positive states such as *"comfort"* [P293], *"calm"* [P745], *"content"* [P665] and simply *"a happy cow produces more milk and better milk"* [P660]. Also, participants referenced minimizing negative states, e.g. *"stress free"* [P45] and *"so they are not depressed"* [P818].

Most participants included one animal welfare value in their responses, with a median value of 1.45 (range: 0 to 5). For example, the comment *"clean environment with access to pasture, good food, hormone and antibiotic free, good care"* [P902] referenced *biological functioning* (clean environment, good food), *natural living* (access to pasture), *drugs* (hormone and antibiotic free) and *humane care* (good care).

Relationship Between Demographics and Housing Acceptability

Overall, group housing was most accepted (75.8%), followed by pair (66.0%) and individual housing (31.5%) (Figure 6). No relationship was found between calf housing acceptance and any of the following demographics: age, education, household income and previous pet ownership. However, we found an association between gender, area of residency, previous livestock handling experience, having a loved one in the dairy industry, prior experience visiting dairy related State Fair locations, and social media presence as it relates to individual calf housing (Table 7). Male participants were more accepting of individual calf housing compared to female participants (38.8 ± 2.3% SE vs. 27.6 ± 1.5%, respectively; $P < 0.001$). Rural residents were more accepting of individual calf housing compared to urban residents (43.0 ± 3.2% vs. 28.8 ± 1.4%, respectively; $P <$

0.001). Participants with prior livestock handling experience were more accepting of individual calf housing compared to participants without prior livestock handling experience (49.2 ± 3.2% vs. 27.3 ± 1.4%, respectively; $P < 0.001$). Participants that had a loved one in the dairy industry were more accepting of individual calf housing compared to participants who did not have a loved one in the dairy industry (44.4 ± 3.0% vs. 27.9 ± 1.4%, respectively; $P < 0.001$). Participants that had not visited dairy related State Fair locations were more accepting of individual calf housing compared to participants that had visited cattle related locations at the State Fair (40.1 ± 4.1% vs. 30.4 ± 1.3%, respectively; $P = 0.006$). Finally, participants that reported not using any of the listed social media platforms were more accepting of individual calf housing compared to participants that reported using one or more of the them (40.7 ± 3.3% vs. 29.6 ± 1.4%, respectively; $P = 0.003$).

Similarly, male participants were more accepting of pair calf housing compared to female participants (68.9 ± 2.2% vs. 64.5 ± 1.6%, respectively; $P = 0.046$). Participants with prior livestock handling experience were more accepting of pair calf housing compared to participants without prior livestock handling experience (72.0 ± 2.8% vs. 64.4 ± 1.5%, respectively; $P = 0.040$). Participants with prior experience visiting livestock farms were more accepting of pair calf housing compared to participants without prior experience visiting livestock farms (68.8 ± 1.6% vs. 61.0 ± 2.2%, respectively; $P = 0.016$). Lastly, participants that reported no plant-based alternative consumption habits were more neutral of pair calf housing compared to participants that reported dairy-alternative consumption habits (24.5 ± 1.7% vs. 15.9 ± 1.4%, respectively; $P < 0.001$).

The only associations between demographic and acceptance of group housing was dairy consumption habits. Participants that reported consuming dairy products were more neutral of group housing compared to participants that reported no dairy product consumption (17.4 ± 1.1% vs. 8.4 ± 3.1%, respectively; $P < 0.001$).

Reasons for Calf Housing Acceptance

Table 6 displays all themes mentioned and acceptance of each housing option. Similar to responses to the question about what calves need for a good life, participants often included more than one theme in their response.

Participants that accepted individual calf housing provided responses covering the following themes (in decreasing order of frequency): *individual health attention*, *environmental quality*, *lack of socialization concerns*, *conditional acceptance*, *visual/auditory interaction*, *ease of management*, and *space allowance*. Participants that rejected individual calf housing (most of whom indicated some level of acceptance of either pair or group housing, or both) provided responses covering the following themes (in decreasing order of frequency): *lack of socialization*, *lack of space allowance*, *unnaturalness*, and *conditional acceptance*.

Participants that accepted pair housing provided responses covering the following themes (in decreasing order of frequency): *socialization*, *compromise between housing systems*, *management concerns*, *environmental quality*, *space allowance*, and *conditional*

acceptance. Participants that rejected pair housing provided responses covering the following themes (in decreasing order of frequency): *lack of space allowance, lack of socialization, management concerns,* and *unnaturalness*.

Participants that accepted group housing provided responses covering the following themes (in decreasing order of frequency): *socialization*, *space allowance*, *management concerns*, *environmental quality*, *previous experience*, and *conditional acceptance*. Participants that rejected group housing provided responses covering the following themes (in decreasing order of frequency): *unnaturalness*, *management concerns*, and *lack of space allowance*.

Individual Housing.

A total of 412 participants (out of 1,310) stated that they *agreed* or *strongly agreed* with the statement, *"this housing option is acceptable to me,"* as it pertains to individual calf housing. Only 15.5% of participants that accepted individual calf housing chose to provide the reasoning behind their choice. A total of 8 themes were identified in response to accepting individual calf housing (in decreasing order of frequency): *individual health attention*, *environmental quality*, *lack of socialization concerns*, *conditional acceptance*, *visual/auditory interaction*, *ease of management*, and *space allowance*.

When discussing acceptance regarding individual calf housing, the most common theme was *individual health attention* (29.7%) referencing how individual calf housing is *"best for controlling diseases and nutrition intake"* [P1124]. Participants referenced calves

having individualized attention for treatment and nutrition, the housing option controlling for disease, and overall better health monitoring. The second most reoccurring theme was *environmental quality* (21.9%). This theme referenced housing characteristics with limited other detail, referenced food or water availability, or safety of the housing. Participants said the housing is *"safe and clean"* [P812] and *"it protects the animal"* [P728].

There was a handful of participants that selected individual calf housing as acceptable, but had *lack of socialization concerns* (20.3%) (e.g., *"it's good to inspect each calf individual[ly] but they should be with their friends and family"* [P771] *and "being alone is bad for health"* [P1192]). Another prominent theme was that participants expressed *conditional acceptance* of individual housing (12.5%). Participants commonly said they accepted individual housing *"as long as it's just for a while"* [P964].

A theme that was just as common as *conditional acceptance* was *visual/auditory interaction* (12.5%). This theme included respondents saying that this housing option was acceptable to them because the calf was near its peers and could visually see or hear other calves, or participants mentioned this was acceptable because calves do not need physical contact. Participants commonly said that *"they can still interact through movements"* [P976], *"[calves] still have [a] connection between each other"* [P1157], and *"[they are] still in [the] vicinity of other [calves]"* [P499]. A less common theme was *ease of management* (6.3%). Participants referenced that this housing option allows *"easy access"* [P1180] and it is *"more manageable"* [P1275]. A few participants mentioned that individual housing is

acceptable to them because of its *space allowance* (4.7%) referring to the option as *"roomy"* [P1268] and the calf had *"adequate space"* [P495].

A total of 616 participants (out of 1,310) stated that they *disagreed* with the statement, *"this housing option is acceptable to me,"* as it pertains to individual calf housing. Only 33.8% of participants that rejected individual calf housing chose to provide the reasoning behind their decision. A total of six themes were identified in response to accepting individual calf housing (in decreasing order of frequency): *lack of socialization*, *lack of space allowance*, *unnaturalness*, and *conditional acceptance*.

The most commonly referenced theme mentioned of participants that rejected individual calf housing was *lack of socialization* (71.6%). Similar to the participants that said they neither accept nor reject individual calf housing, participants that rejected individual calf housing were dissatisfied with the socialization opportunities the calves' possessed and occasionally referenced negative affective state feelings. Participants said that the calf is *"painfully isolated"* [P436] in this housing option and that *"they are herd animals; they shouldn't be isolated from their kind"* [P162]. There were multiple participants that mentioned there was a link between socialization and mental health saying *"health is not only physical, this disregards the social aspect of an animal's life"* [P697] and that there is *"stress from knowing others are near, but not knowing anything about them"* [P488].

The next common theme mentioned by participants that rejected individual calf housing was *lack of space allowance* (29.8%). Participants said that individual calf housing

"seems confining" [P1301] and simply it is *"too small"* [P652]. Participants also mentioned that this housing option does not allow calves room to express natural behaviors (i.e. *"[the calves] cannot move freely"* [P652], *"they do not have enough space for [the] calves to run,"* [P716], and *"no room to exercise"* [P598]. Additionally, participants rejected individual calf housing because they felt it was *unnatural* (9.1%) (e.g.,*"very unnatural"* [P485]).

Participants that rejected individual calf housing stated that this housing option would have *conditional acceptance* (3.8%). Participants said *"unless a contagious disease is ailing this creature, then none should be subjected to this"* [P42] and *"depends on the time they spend there, if [it] is just to sleep and eat it should be good, but if they spend most of the time in there, then it is abuse"* [P913].

Pair Housing.

A total of 864 participants (out of 1,310) stated that they *agreed* or *strongly agreed* with the statement, *"this housing option is acceptable to me,"* as it pertains to pair calf housing. Only 16.3% participants that accepted pair calf housing chose to provide the reasoning behind their decision. A total of 6 themes were identified in response to accepting pair calf housing (in decreasing order of frequency): *socialization*, *compromise between housing systems*, *management concerns*, *environmental quality*, *space allowance*, and *conditional acceptance*.

The most commonly referenced theme was *socialization* (56.0%). Participants commonly mentioned some description of play behavior or interaction between the calves and having a friend/calf/family member. Examples include *"companionship is important"* [P216], *"it shows the freedom that calves have to socialize with other calves which is healthy for their mentality"* [P709] and *"isolation is not natural to cows in the wild, what right do we have to take that freedom away from them?"* [P1176]. The next most common theme for participants that accepted pair housing was *compromise between housing systems* (15.6%). Participants referenced aspects of socialization opportunities for the calves and manageability for the farmer, simply put *"[it's] a good compromise of benefits"* [P1256]. Other participants said *"a pair allows for some control with good social opportunities"* [P500] and the housing options allows for *"some space, some contact, but with the chance for the farmer to get some sense of feeding; not so much mixing with others that infectious diseases are easily spread"* [P1063].

A few participants that found pair housing acceptable, also thought that it had *management concerns* (14.9%). Participants had concerns about spreading disease between calves, farmer's ability to manage it, resource availability, and bullying. Participants mentioned that this housing option was *"ok for calves but more work for farmer"* [P613], there is a potential *"problem with bullying"* [P317], and *"I think it is important for the calves to socialize but [I] don't want them to get sick from each other or develop bad habits from watching each other"* [P318].

Similar to individual housing, participants accepted pair housing because of *environmental quality* (9.9%). This theme referenced housing characteristics with limited other detail, referenced food or water availability, or safety and hygiene of the housing, most commonly saying it was *"clean and safe"* [P495]. An equal number of participants accepted pair housing because of *space allowance* (9.9%). Participants mentioned that this housing option allows *"room to walk"* [P680] and it was *"not crowded"* [P883]. The final theme mentioned by participants was that they *accepted* pair housing *conditionally* (3.5%), saying this option was acceptable *"but not long term"* [P1209].

A total of 185 participants (out of 1,310) stated that they *disagreed* or *strongly disagreed* with the statement, *"this housing option is acceptable to me,"* as it pertains to pair calf housing. Only 37.3% of participants that rejected pair housing chose to provide the reasoning behind their decision. A total of 4 themes were identified in response to rejecting pair calf housing (in decreasing order of frequency): *lack of space allowance*; *lack of socialization*; *management concerns*; and *unnaturalness*.

Participants were concerned that pair housing has a *lack of space allowance* (69.6%). Participants said *"they need room to run and play"* [P1193], *"what if they…get aggressive in this confined space"* [P1047], and that the housing option *"looks like a horribly small space"* [P303]. About half as many participants were concerned about the *lack of socialization* (27.5%). One participant said there is, *"not enough…socialization; imagine being stuck with one person for life"* [P1277].

Participants that rejected pair housing also had *management concerns*. Participants were concerned about spread of disease and unequal food consumption (11.6%). A few responses include *"[I] can't tell if they are both eating equally"* [P155] and *"illness can spread [in this housing option]"* [P971]. An equal number of participants (11.6%) were concerned that pair housing is *unnatural*. All data in the unnatural theme, regarding rejection of pair housing, referenced to lack of pasture access, one participant specifically said, *"I'd rather see them out in the field nursing off their mother"* [P225].

Group Housing.

A total of 993 participants (out of 1,310) stated that they *agreed* or *strongly agreed* with the statement, *"this housing option is acceptable to me,"* as it pertains to group calf housing. Only 17.8% of participants that accepted group calf housing chose to provide the reasoning behind their decision. A total of 6 themes were identified in response to accepting group calf housing (in decreasing order of frequency): *socialization*, *space allowance*, *management concerns*, *environmental quality*, *previous experience*, and *conditional acceptance*.

Most participants found group housing acceptable because of the amount of *socialization* the calves receive (50.8%). If participants mentioned some description of play behavior, *"community"* [P1154], *"companionship"* [P436], or *"herd mentality"* [P861] and positive emotions associated with addition of calves they were placed in the socialization theme. Some participants said *"health will be better with better socialization"* [P524] and *"[calves are] able to become accustomed to being in a herd"* [P1207]. Next, participants accepted

group housing due to *space allowance* (32.8%). Some participants felt the group housing option allowed *"enough space to live"* [P38] and *"space to develop properly"* [P1220].

Even though participants found group housing to be acceptable to them, they still had (3) *management concerns* (17.5%). Concerns included reference to disease control, farmer comfort, handler safety, calf safety, hygiene, and humane handling. Participants said *"I like the social piece to it – cows like to be in herds; [only] if they do not harm each other"* [P660] and this is acceptable *"as long as they are in appropriate age groups to minimize disease spread between groups"* [P1303].

Additionally, participants accepted group housing due to *environmental quality* (7.3%). This theme referenced food or water availability, or safety of the housing. One participant said, *"[it] appears clean [and has] access to food and water… [the calves are] sheltered and safe"* [P205]. A few participants mentioned that they accepted group housing because of *previous experience* (2.3%). One participant said, *"that's the way my dad did it because it was better for them to be integrated later into the herd; he had older heifers mixed with younger heifers"* [P685]. Finally, only 1.1% of participants said they had *conditional acceptance* of group housing, saying it was acceptable *"for short amounts of time"* [P95].

A total of 97 participants (out of 1,310) stated that they *disagreed* with the statement, *"this housing option is acceptable to me,"* as it pertains to group calf housing. Only 35.1% of participants that rejected group housing chose to provide the reasoning behind

their decision. A total of 3 themes were identified in response to rejecting group calf housing (in decreasing order of frequency): *unnaturalness*, *management concern*, and *lack of space allowance*.

Majority of participants rejected group housing because they felt it was *unnatural* (52.9%). Participants mentioned that *"they should be allowed outdoors"* [P188] because *"they need to eat grass and should have both sun and shade options"* [P270], and *"no mothers"* [P36]. Participants also rejected group housing because of *management concerns* (32.4%). Participants stated that there would be *"health challenges"* [P351] with this option and housing calves together *"can spread infection"* [P152]. Finally, participants felt that this housing option had a *lack of space allowance* (20.6%) (e.g., *"not big enough"* [P843]).

DISCUSSION

To our knowledge, this is the first study to examine public acceptance for dairy calf housing systems. This study investigated how a large sample of diverse citizens perceived dairy calf housing and dairy calf welfare. By convenience sampling at the Minnesota State Fair, our participants were potentially less engaged in animal food production issues; however, our participant sample chose to visit the Driven to Discover building which might imply that they were supportive of research and education.

Farm Animal Welfare Concerns and Values

In recent years, the public is making their concern for animal welfare more evident. Citizens have introduced animal housing issues into legislation and companies have made

an effort to adapt marketing of products to seem more appealing to consumers concerned with animal welfare (Clark et al., 2016). There have been studies that focused on consumers' willingness to pay for products that were produced with animal welfare in mind, but little research has focused on the citizen's perspective on farm animal welfare values and perceptions (Vanhonacker et al., 2007; Spooner et al., 2014).

Previous research has identified that the public is concerned about the biological functioning of farm animals, most notably identifying that food, water, shelter, and veterinary care is extremely important for animal well-being (Ventura et al., 2016). Even though biological functioning was the highest noted value among participants in both the Likert scale section (98.5% stated this was *important*) and open-ended question probing participants on what a calf needs to have a good life (69.5%), this was less commonly referenced in housing acceptance. *Individual health attention* was the most commonly referenced theme participants used to explain their acceptance for individual calf housing, followed by *environmental quality*. However, in pair and group housing, participants were most concerned with *socialization* of the dairy calf which suggests a concern for natural living. *Environmental quality* was referenced in all housing options regarding acceptance; however, it was less frequent than natural living factors. The participants that rejected pair and group calf housing commonly referenced *management concerns* as their reasoning which incorporated factors related to health (11.6% and 32.4%, respectively). Previous research also indicates that citizens find biological functioning to be an important factor when determining an animal's welfare (Spooner et al., 2014).

Throughout the current survey, participants placed a high value on natural living in regard to their vision of animal welfare. Participants referenced natural living in their response to what a calf needs to have a good life (49.6%) and stated it was *important* for the calf to be able to play with other calves (85.4%). The most noted concern by participants who rejected individual and pair housing, was that they found the *lack of socialization* unacceptable (71.6% and 27.5%, respectively). Additionally, participants were highly concerned with space allowance. Participants that rejected individual and pair calf housing mentioned that the *lack of space allowance* was unacceptable (29.8% and 69.6%, respectively). Similarly, *space allowance* was a major contributor to acceptance of group housing among participants (32.8%). Prior research has also referenced the publics' concern for behavioral freedom and space allowance (Ellis et al., 2009; Ventura et al., 2016). Other studies have found that "naturalness" is a highly desired trait for the modern farm (Weary et al., 2015a; Yunes et al., 2017). Studies have noted that the public is concerned that the modern farm has no regard for natural living (Vanhonacker et al., 2007) and inhibits animals from expressing natural behaviors due to inhumane conditions (Paarlberg, 2009). Participants of this study that rejected individual, pair, and group housing mentioned that all three housing options were *unnatural* (9.1%, 11.6%, 52.9% as the reason for their choice, respectively), with pasture access being the main concern. It appears that the public perceives outdoor access and exercise as needed for animals to have a good quality of life (Prickett, 2008).

The concern for affective state was less prominent throughout our survey; however, this could be due to phrasing of questions. Most questions were probing participants for

inputs of a good quality of life for the calf and since affective state is usually referred to as an output, this could be the reason it was mentioned less often by participants. However, participants did find it *important* that the calf be treated calmly and respectfully by its owner (95.1%) and had the ability to play with other calves (85.4%). Participants did reference the calf's need to endure positive states of emotion when asked what a calf needs to have a good quality of life (4.7%). Limited literature is available of the public specifically mentioning the cow's need to be happy (Ventura et al., 2016).

Participants perspective of animal welfare expanded beyond the three spheres framework and considered "human care" to be a vital piece of animal well-being (Fraser et al., 1997; Ventura et al., 2016). A majority of participants thought it was necessary for a calf to be treated calmly and respectfully by its owner (95.1%). Additionally, participants also mentioned humane care in their response to what a calf needs to have a good life (20.2%). Other studies have found similar findings that the public places value on gentle handling and the farmer-animal bond (Spooner et al., 2014; Weary et al., 2015a).

The concern of drug use on dairy farms was also an issue that was brought up by participants (1.3%). Even though this concern was less prominent, other studies have found similar results (Ventura et al., 2016; Yunes et al., 2017). Participants "condemned the overuse of antibiotics and hormones" (Ventura et al., 2016) due to the perception that antibiotics harm the environment, human health, and the quality of life of the cow.

Demographic Influence on Acceptance of Calf Housing

Previous research has suggested that gender may play a role in animal welfare concerns. Prior studies have noted that females have a greater empathy and concern for farm animal well-being (Tiplady et al., 2012). Women have been found to feel a moral obligation to be protectors of animals while men are typically less concerned about animal stewardship, partaking in sporting activities such as hunting (Herzog, 2007). In the current study, we found associations between gender and housing acceptance. Male participants were more accepting of individual and pair calf housing compared to females, which may suggest that females have a greater concern for dairy calf welfare. Also, age has been found to influence purchasing decisions. Middle aged people have been found to have more animal-centered opinions compared to younger people (María, 2006), therefore, choosing to pay more for animal friendly products and purchase less animal-derived clothing products, suggesting a greater regard for animal welfare. In the current study, we did not find associations between age and housing acceptability.

Additionally, we did not find associations between level of education and calf housing acceptance. Prior research suggests that as education level increases, consumers' preference for animal friendly products increases, which suggests an underlying concern for animal welfare (Hughes, 1995; Honkanen and Ottar Olsen, 2009). It is possible that since our sample population had a higher level of education, we did not have enough variability in the sample to discover associations between education and housing acceptance. Also, previous research suggests that rural residences have a greater awareness of farming issues and more detailed knowledge of reasons underlying farming

practices (Harper and Makatouni, 2002b). In contrast, other research has found that residency effects do not have an association with animal welfare or have unexpected effects (Kendall et al., 2006). The current study found an association between residency and acceptance of individual calf housing. Rural residents were more accepting of individual calf housing compared to urban residents. Additionally, the current study found associations between individual and pair calf housing acceptance and prior livestock experience. Participants that had prior experience working with livestock were more accepting of individual and pair calf housing compared to participants without livestock experience, which was consistent with previous studies that determined farming experience affected animal welfare standards (Vanhonacker et al., 2007). There have been few studies that have looked at associations between area of residency and how this may affect animal welfare views (Muldoon et al., 2010). Recently, the public has become interested in touring livestock farms to gain a better understanding of where their food comes from and producers hope to give the public a more detailed understanding of farming practices, yet little research has been done to determine if this impacts public perception (Barbieri et al., 2016; Ventura et al., 2016). In the current study, we found associations between previous farm visiting experience and acceptance of pair housing. Participants that had visited a farm in the past were more accepting of pair calf housing compared to participants without prior experience visiting livestock farms. Additionally, we found associations between previous experience visiting dairy related locations at the State Fair and individual calf housing acceptance. Participants that had not visited cattle related State Fair locations were more accepting of individual calf housing compared to participants that had visited cattle related locations at the State Fair.

Furthermore, we found associations between having a loved one in the dairy industry and acceptance of individual calf housing. Participants that have a loved one in the dairy industry were more accepting of individual housing compared to participants that did not. We hypothesized that having a loved one in the dairy industry would contribute to approval of management practices, therefore, participants would be more accepting of individual housing. To our knowledge, this is the first study to find associations between interpersonal relationships effecting dairy welfare perceptions.

Previous research suggests that current or childhood pet ownership relates to animal welfare attitudes among companion and non-companion animals (Paul and Serpell, 1993; Prokop and Tunnicliffe, 2010). However, the current study did not find associations between adult pet ownership and calf housing acceptance. This could be due to the overwhelming number of participants that reported owning a pet at some point in their life (94.0%), therefore we suggest that the number of participants without prior pet ownership experience was not sufficient to detect significance.

We also wanted to consider social media use when determining animal welfare values. Previous research has indicated that social media can affect consumer demand and purchases of animal derived products (Tonsor and Olynk, 2011). The information being presented to viewers can leave a psychological footprint, which could change future purchasing decisions and acceptance of the industry (Tonsor et al., 2009a). The current study found associations between social media use and acceptance of individual calf

housing. Participants that reported not using one of the listed social media platforms were more accepting of individual calf housing compared to participants that had reported using one or more of them. Potentially this could be attributed to lack of exposure to undercover animal abuse videos.

Finally, we set out to examine the relationship between dairy consumption habits and calf housing acceptance. Participants that reported consuming dairy products were more neutral of group housing compared to participants that reported no dairy product consumption. Similarly, participants that reported no plant-based alternative consumption habits were more neutral of pair calf housing compared to participants that reported dairy-alternative consumption. No prior studies have found an association between dairy and plant-based alternative product consumption and animal welfare preferences. Previous studies have found that consumers purchase free-range or organic food products due to perceptions of higher welfare standards and healthiness (Ellis et al., 2009).

CONCLUSIONS

This study was the first to explore perceptions, values, and acceptance of dairy calf welfare among American citizens. Overall, dairy calves housed in groups was the most accepted housing option, followed by pair, and individual calf housing. A majority of the public found group housing acceptable because of the socialization aspects and space allowance for the calf, suggesting that the public desires a more natural lifestyle for farm animals. Currently, individual calf housing is the most used housing system for calves in the United States. This study will allow industry stakeholders to understand public

concerns and values to consider adopting calf housing options that incorporate socialization opportunities and greater space allocation for their calves. This study can be used as a reference for the dairy industry to adopt more socially acceptance calf housing practices.

REFERENCES

Abeyesinghe, S., J. Jamieson, C. Wathes, M. Reiss, D. Allen, and L. Asher. 2012. Measuring the success of a farm animal welfare education event. Anim. Welf. 21:65–75. doi:10.7120/096272812799129402.

Aguirre, V., and A. Orihuela. 2010. Assessment of the impact of an animal welfare educational course with first grade children in rural schools in the state of morelos, mexico. Early Child. Educ. J. 38:27–31. doi:10.1007/s10643-010-0384-2.

Ajzen, I. 1991. The theory of planned behavior. Orgnizational Behav. Hum. Decis. Process. 50:179–211. doi:10.1016/0749-5978(91)90020-T.

Ajzen, I. 2001. Nature and Operation of Attitudes. Annu. Rev. Psychol. 52:27–58. doi:10.1146/annurev.psych.52.1.27.

Allen, E., and C.A. Seaman. 2007. Likert scales and data analyses. Qual. Prog. 64–65.

Andrews, D., B. Nonnecke, and J. Preece. 2003. Electronic survey methodology: A case study in reaching hard-to-involve internet users. Int. J. Hum. Comput. Interact. 16:185–210. doi:10.1207/S15327590IJHC1602_04.

Babu, L.K., H. Pandey, R.C. Patro, and A. Sahoo. 2009. Hemato-biochemical changes, disease incidence and live weight gain in individual versus group reared calves fed on different levels of milk and skim milk. Anim. Sci. J. 80:149–156. doi:10.1111/j.1740-0929.2008.00620.x.

Babu, L.K., H.N. Pandey, and A. Sahoo. 2004. Effect of individual versus group rearing on ethological and physiological responses of crossbred calves. Appl. Anim. Behav. Sci. 87:177–191. doi:10.1016/j.applanim.2004.01.006.

Barbieri, C., S. Xu, C. Gil-Arroyo, and S.R. Rich. 2016. Agritourism, Farm Visit, or.. ? A

Branding Assessment for Recreation on Farms. J. Travel Res. 55:1094–1108. doi:10.1177/0047287515605930.

Benard, M., and T. de Cock Buning. 2013. Exploring the potential of Dutch pig farmers and urban-citizens to learn through frame reflection. J. Agric. Environ. Ethics 26:1015–1036. doi:10.1007/s10806-013-9438-y.

Blokhuis, H.J. 2008. International cooperation in animal welfare: the Welfare Quality® project. Acta Vet. Scand. 50:1–5. doi:10.1186/1751-0147-50-s1-s10.

Bøe, K.E., and G. Færevik. 2003. Grouping and social preferences in calves, heifers and cows. Appl. Anim. Behav. Sci. 80:175–190. doi:10.1016/S0168-1591(02)00217-4.

Boogaard, B.K., B.B. Bock, S.J. Oosting, and E. Krogh. 2010. Visiting a farm: An exploratory study of the social construction of animal farming in Norway and the Netherlands based on sensory perception. Int. J. Sociol. Agric. Food 17:24–50.

Boogaard, B.K., L.J.S. Boekhorst, S.J. Oosting, and J.T. Sørensen. 2011. Socio-cultural sustainability of pig production: Citizen perceptions in the Netherlands and Denmark. Livest. Sci. 140:189–200. doi:10.1016/j.livsci.2011.03.028.

Braun, V., and V. Clarke. 2013. Successful Qualitative Research: A Practical Guide for Beginners. 1st ed. SAGE Publications Ltd, London.

Brom, F.W.A. 2000. Food, consumer concerns, and trust: Food ethics for a globalizing market. J. Agric. Environ. Ethics 12:127–139. doi:https://doi.org/10.1023/A:1009586529518.

Broom, D.M. 1991. Animal welfare: concepts and measurement. J. Anim. Sci. 69:4167–4175. doi:10.2527/1991.69104167x.

Busch, G., and A. Spiller. 2018. Consumer acceptance of livestock farming around the

globe. Anim. Front. 8:1–3. doi:10.1093/af/vfx005.

Busch, G., D.M. Weary, A. Spiller, and M.A.G. Von Keyserlingk. 2017. American and German attitudes towards cowcalf separation on dairy farms. PLoS One 12:1–20. doi:10.1371/journal.pone.0174013.

California Code, Health and Safety Code - HSC § 25990. .

Cardoso, C.S., M.A.G. Von Keyserlingk, and M.J. Hötzel. 2017. Brazilian citizens: Expectations regarding dairy cattle welfare and awareness of contentious practices. Animals 7. doi:10.3390/ani7120089.

Carlson, L., S. Grossbart, and A. Walsh. 1990. Mothers' communication orientation and consumer-socialization tendencies. J. Advert. 19:27–38. doi:10.1080/00913367.1990.10673190.

Ceballos, M.C., A.C. Sant'Anna, X. Boivin, F. de O. Costa, M.V. de L. Carvalhal, and M.J.R. Paranhos da Costa. 2018. Impact of good practices of handling training on beef cattle welfare and stockpeople attitudes and behaviors. Livest. Sci. 216:24–31. doi:10.1016/j.livsci.2018.06.019.

Cembalo, L., F. Caracciolo, A. Lombardi, T. Del Giudice, K.G. Grunert, and G. Cicia. 2016. Determinants of individual attitudes toward animal welfare-friendly food products. J. Agric. Environ. Ethics 29:237–254. doi:10.1007/s10806-015-9598-z.

Chua, B., E. Coenen, J. van Delen, and D.M. Weary. 2002. Effects of pair versus individual housing on the behavior and performance of dairy calves. J. Dairy Sci. 85:360–364. doi:10.3168/jds.S0022-0302(02)74082-4.

Clark, B., L.A. Panzone, G.B. Stewart, I. Kyriazakis, J.K. Niemi, T. Latvala, R. Tranter, P. Jones, and L.J. Frewer. 2019. Consumer attitudes towards production diseases in

intensive production systems. PLoS One 14:e0210432. doi:10.1371/journal.pone.0210432.

Clark, B., G.B. Stewart, L.A. Panzone, I. Kyriazakis, and L.J. Frewer. 2016. A systematic review of public attitudes, perceptions and behaviours towards production diseases associated with farm animal welfare. J. Agric. Environ. Ethics 29:455–478. doi:10.1007/s10806-016-9615-x.

Cobanoglu, C., P.J. Moreo, and B. Warde. 2001. A comparison of mail, fax and web-based survey methods. Int. J. Mark. Res. 43:1–15. doi:10.1177/147078530104300401.

Coffey, A., and P. Atkinson. 1994. Making Sense of Qualitative Data: Complementary Research Strategies. A. Coffey and P. Atkinson, ed. Sage, Thousand Oaks, CA.

Coleman, G. 2018. Public animal welfare discussions and outlooks in Australia. Anim. Front. 8:14–19. doi:10.1093/af/vfx004.

Costa, J.H.C., M.A.G. von Keyserlingk, and D.M. Weary. 2016. Invited review: Effects of group housing of dairy calves on behavior, cognition, performance, and health. J. Dairy Sci. 99:2453–2467. doi:10.3168/jds.2015-10144.

Daly, B., and L.L. Morton. 2006. An investigation of human-animal interactions and empathy as related to pet preference, ownership, attachment, and attitudes in children. Anthrozoos 19:113–127. doi:10.2752/089279306785593801.

Destrez, A., E. Haslin, and X. Boivin. 2018. What stockperson behavior during weighing reveals about the relationship between humans and suckling beef cattle: A preliminary study. Appl. Anim. Behav. Sci. 209:8–13. doi:10.1016/j.applanim.2018.10.001.

Duncan, I.J.H. 1993. The science of animal well-being. Anim. Welf. Inf. Cent. Newsl. 4:4–7.

Dutkiewicz, J. 2018. Transparency and the factory farm: Agritourism and counter-activism at Fair Oaks Farms. Gastron. J. Crit. Food Stud. 18:19–32. doi:10.1525/gfc.2018.18.2.19.

Duve, L.R., and M.B. Jensen. 2012. Social behavior of young dairy calves housed with limited or full social contact with a peer. J. Dairy Sci. 95:5936–5945. doi:10.3168/jds.2012-5428.

Ellis, K.A., K. Billington, B. McNeil, and D.E.F. McKeegan. 2009. Public opinion on UK milk marketing and dairy cow welfare. Anim. Welf. 18:267-282 (16).

Eurobarometer. 2016. Special Eurobarometer 442 Report Attitudes of Europeans towards Animal Welfare.

Færevik, G., M.B. Jensen, and K.E. Bøe. 2006. Dairy calves social preferences and the significance of a companion animal during separation from the group. Appl. Anim. Behav. Sci. 99:205–221. doi:10.1016/j.applanim.2005.10.012.

Fishbein, M., and I. Ajzen. 1975. Beliefm Attitude, Intention, and Behavior: An Introduction to Theory and Reasch. Addison-Welsey, Readings, MA.

Five Freedoms of the Farm Animal Welfare Council. 1993. . Accessed. http://www.fawc.org.uk/freedoms.htm.

Fraser, D., D.M. Weary, E.A. Pajor, and B.N. Milligan. 1997. A scientific conception of animal welfare that reflects ethical concerns. Anim. Welf. 6:187–205.

Gaillard, C., R.K. Meagher, M.A.G. von Keyserlingk, and D.M. Weary. 2014. Social housing improves dairy calves' performance in two cognitive tests. PLoS One 9.

doi:10.1371/journal.pone.0090205.

Glasow, P.A. 2005. Fundamentals of Survey Research Methodology. Accessed June 22, 2019. http://www.uky.edu/~kdbrad2/EPE619/Handouts/SurveyResearchReading.pdf.

Gulliksen, S.M., E. Jor, K.I. Lie, I.S. Hamnes, T. Løken, J. Åkerstedt, and O. Østerås. 2009a. Enteropathogens and risk factors for diarrhea in Norwegian dairy calves. J. Dairy Sci. 92:5057–5066. doi:10.3168/jds.2009-2080.

Gulliksen, S.M., K.I. Lie, T. Løken, and O. Østerås. 2009b. Calf mortality in Norwegian dairy herds. J. Dairy Sci. 92:2782–2795. doi:10.3168/jds.2008-1807.

Hänninen, L., A.M. de Passillé, and J. Rushen. 2005. The effect of flooring type and social grouping on the rest and growth of dairy calves. Appl. Anim. Behav. Sci. 91:193–204. doi:10.1016/j.applanim.2004.10.003.

Harper, G.C., and A. Makatouni. 2002a. Consumer perception of organic food production and farm animal welfare. Br. Food J. 104:287–299. doi:10.1108/00070700210425723.

Harper, G.C., and A. Makatouni. 2002b. Consumer perception of organic food production and farm animal welfare. Br. Food J. 104:287–299. doi:10.1108/00070700210425723.

Heleski, C.R., A.G. Mertig, and A.J. Zanella. 2004. Assessing attitudes toward farm animal welfare: A national survey of animal science faculty members1. J. Anim. Sci. 82:2806–2814. doi:10.2527/2004.8292806x.

Heleski, C.R., A.G. Mertig, and A.J. Zanella. 2006. Stakeholder attitudes toward farm animal welfare. Anthrozoos 19:290–307. doi:10.2752/089279306785415439.

Hemsworth, P.H., G.J. Coleman, and J.L. Barnett. 1994. Improving the attitude and behaviour of stockpersons towards pigs and the consequences on the behaviour and reproductive performance of commercial pigs. Appl. Anim. Behav. Sci. 39:349–362. doi:10.1016/0168-1591(94)90168-6.

Hemsworth, P.H., G.J. Coleman, J.L. Barnett, S. Borg, and S. Dowling. 2002. The effects of cognitive behavioral intervention on the attitude and behavior of stockpersons and the behavior and productivity of commercial dairy cows. J. Anim. Sci. 80:68–78. doi:10.2527/2002.80168x.

Herzog, H.A. 2007. Gender differences in human-animal interactions: A review. Anthrozoos 20:7–21. doi:10.2752/089279307780216687.

Hills, A.M. 1983. The Motivational Basis of Attitudes Towards Animals. Soc. Anim. 1:111–128.

Holm, L., M.B. Jensen, and L.L. Jeppesen. 2002. Calves' motivation for access to two different types of social contact measured by operant conditioning. Appl. Anim. Behav. Sci. 79:175–194. doi:10.1016/S0168-1591(02)00137-5.

Honkanen, P., and S. Ottar Olsen. 2009. Environmental and animal welfare issues in food choice. Br. Food J. 111:293–309. doi:10.1108/00070700910941480.

Hughes, D. 1995. Animal welfare. Br. Food J. 97:3–7. doi:10.1108/00070709510104529.

Hughes, D. 1997. Animal Welfare: The Food Industry and Government. L.T. Wallace and W.R. Schroder, ed. Boston: Kluwer Academic Publishers, Springer, Boston, MA.

Jamieson, J., M.J. Reiss, D. Allen, L. Asher, M.O. Parker, C.M. Wathes, and S.M. Abeyesinghe. 2015. Adolescents care but don't feel responsible for farm animal

welfare. Soc. Anim. 23:269–297. doi:10.1163/15685306-12341283.

Jamison, W. V, and W.M. Lunch. 1992. Rights of animals, perceptions of science, and political activism: Profile of American animal rights activists. Sci. Technol. Hum. Values 17:438–458. doi:10.1177/016224399201700402.

Jeong, H.-J., and W.-C. Lee. 2016. The level of collapse we are allowed: Comparison of different response scales in Safety Attitudes Questionnaire. Biometrics Biostat. Int. J. 4:1–7.

Kauppinen, T., A. Vainio, A. Valros, H. Rita, and K.M. Vesala. 2010. Improving animal welfare: Qualitative and quantitative methodology in the study of farmers' attitudes. Anim. Welf. 19:523–536.

Kauppinen, T., A. Valros, and K.M. Vesala. 2013. Attitudes of Dairy Farmers toward Cow Welfare in Relation to Housing, Management and Productivity. Anthrozoos 26:405–420. doi:10.2752/175303713X13697429463718.

Keil, N.M., and W. Langhans. 2001. The development of intersucking in dairy calves around weaning. Appl. Anim. Behav. Sci. 72:295–308. doi:10.1016/S0168-1591(00)00207-0.

Kellert, S.R. 2011. Attitudes toward animals: Age-related development among children. Adv. Anim. Welf. Sci. 1984 43–60. doi:10.1007/978-94-009-4998-0_3.

Kendall, H.A., L.M. Lobao, and J.S. Sharp. 2006. Public concern with animal well-being: Place, social structural location, and individual experience. Rural Sociol. 71:399–428. doi:10.1526/003601106778070617.

von Keyserlingk, M., and D.M. Weary. 2018. Farm animal welfare: Maintaining public trust and social acceptability. J. Anim. Sci. 96:507.

Kidder, L.H., and M. Fine. 1987. Qualitative and quantitative methods: When stories converge. New Dir. Progr. Eval. 1987:57–75. doi:10.1002/ev.1459.

Krawczel, P.D. 2016. Group Housing for Dairy Calves – A Viable Option with Potential Benefits. Accessed June 18, 2019. https://extension.tennessee.edu/publications/Documents/W382.pdf.

Kristensen, E., and E.B. Jakobsen. 2011. Challenging the myth of the irrational dairy farmer; understanding decision-making related to herd health. N. Z. Vet. J. 59:1–7. doi:10.1080/00480169.2011.547162.

Kühl, S., S. Gauly, and A. Spiller. 2019. Analysing public acceptance of four common husbandry systems for dairy cattle using a picture-based approach. Livest. Sci. 220:196–204. doi:10.1016/j.livsci.2018.12.022.

Lagerkvist, C.J., and S. Hess. 2011. A meta-analysis of consumer willingness to pay for farm animal welfare. Eur. Rev. Agric. Econ. 38:55–78. doi:10.1093/erae/jbq043.

Lai, J., H.H. Wang, D.L. Ortega, and N.J. Olynk Widmar. 2018. Factoring Chinese consumers' risk perceptions into their willingness to pay for pork safety, environmental stewardship, and animal welfare. Food Control 85:423–431. doi:10.1016/j.foodcont.2017.09.032.

Lassen, J., P. Sandøe, and B. Forkman. 2006. Happy pigs are dirty! - Conflicting perspectives on animal welfare. Livest. Sci. 103:221–230. doi:10.1016/j.livsci.2006.05.008.

Lecorps, B., D.M. Weary, and M.A.G. von Keyserlingk. 2018. Pessimism and fearfulness in dairy calves. Sci. Rep. 8:1421. doi:10.1038/s41598-017-17214-3.

Leech, N.L., and A.J. Onwuegbuzie. 2007. An array of qualitative data analysis tools : A

call for data analysis triangulation 22:557–584. doi:10.1037/1045-3830.22.4.557.

Lewis, T.H. 2017. Complex Survey Data Analysis with SAS. 1st ed. Chapman and Hall/CRC, Fairfax, Virginia, USA.

Li, X., S. Zito, M. Sinclair, and C.J.C. Phillips. 2018. Perception of animal welfare issues during Chinese transport and slaughter of livestock by a sample of stakeholders in the industry. PLoS One 13:e0197028. doi:10.1371/journal.pone.0197028.

Lidfors, L., and L. Isberg. 2003. Intersucking in dairy cattle - Review and questionnaire. Appl. Anim. Behav. Sci. 80:207–231. doi:10.1016/S0168-1591(02)00215-0.

Losinger, W.C., and A.J. Heinrichs. 1997. Management practices associated with high mortality among preweaned dairy heifers. J. Dairy Res. 64:1–11. doi:10.1017/S0022029996001999.

Lusk, J.L., and F.B. Norwood. 2010. Direct versus indirect questioning: An application to the well-being of farm animals. Soc. Indic. Res. 96:551–565. doi:10.1007/s11205-009-9492-z.

Malone, T., and J.L. Lusk. 2016. Putting the chicken before the egg price: An ex post analysis of California's battery cage ban. J. Agric. Resour. Econ. 41:518–532.

Mancini, M.C., D. Menozzi, F. Arfini, and M. Veneziani. 2018. How do firms use consumer science to target consumer communication? The case of animal welfare. Elsevier.

María, G.A. 2006. Public perception of farm animal welfare in Spain. Livest. Sci. 103:250–256. doi:10.1016/j.livsci.2006.05.011.

McGuirk, S.M. 2008. Disease management of dairy calves and heifers. Vet. Clin. North Am. Food Anim. Pract. 24:139–153. doi:10.1016/j.cvfa.2007.10.003.

McIntyre, L.J. 1999. The Practicial Skeptic: Core Concepts in Sociology. Mayfield Publishing, Mountain View, CA.

McKendree, M.G.S., D.U. Thomson, J.C. Swanson, G.T. Tonsor, and C.A. Wolf. 2016. Public and farmer perceptions of dairy cattle welfare in the United States. J. Dairy Sci. 99:5892–5903. doi:10.3168/jds.2015-10619.

Meagher, R.K., A. Beaver, D.M. Weary, and M.A.G. von Keyserlingk. 2019. Invited review: A systematic review of the effects of prolonged cow–calf contact on behavior, welfare, and productivity. J. Dairy Sci.. doi:10.3168/jds.2018-16021.

Mellor, D., and N. Beausoleil. 2015. Extending the "Five Domains" model for animal welfare assessment to incorporate positive welfare states. Anim. Welf. 24:241–253. doi:10.7120/09627286.24.3.241.

Mench, J.A. 2008. Farm animal welfare in the U.S.A.: Farming practices, research, education, regulation, and assurance programs. Appl. Anim. Behav. Sci. 113:298–312. doi:10.1016/j.applanim.2008.01.009.

Miele, M. 2010. Report Concerning Consumer Perceptions and Attitudes towards Farm Animal Welfare. Accessed June 15, 2019. https://www.researchgate.net/profile/M_Miele/publication/267250171_Report_concerning_consumer_perceptions_and_attitudes_towards_farm_animal_welfare/links/55150cc60cf283ee08397f47.pdf.

Montaño, D.E. 2016. Health Behavior and Health Education: Theory, Research, and Practice. 4th ed. Jossey-Bass, San Francisco, CA.

Mulder, M., and S. Zomer. 2017. Dutch consumers' willingness to pay for broiler welfare. J. Appl. Anim. Welf. Sci. 20:137–154.

doi:10.1080/10888705.2017.1281134.

Muldoon, J., J.M. Williams, A. Lawrence, N. Lakestani, and C. Currie. 2010. Promoting a “duty of care” towards animals among children and young people. Educ. Heal. 28:12–15.

NAHMS, and USDA. 2014. Part I: Reference of Dairy Cattle Health and Management Practices in the United States. Accessed June 20, 2019. https://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy14/Dairy14_dr_PartI.pdf.

Ostović, M., Ž. Mesić, T. Mikuš, K. Matković, and Ž. Pavičić. 2016. Attitudes of veterinary students in Croatia toward farm animal welfare 21–28. doi:10.7120/09627286.25.1.021.

Paarlberg, R. 2009. The ethics of modern agriculture. Society 46:4–8. doi:10.1007/s12115-008-9168-3.

Pardon, B., B. Catry, R. Boone, H. Theys, K. De Bleecker, J. Dewulf, and P. Deprez. 2014. Characteristics and challenges of the modern Belgian veal industry. Vlaams Diergeneeskd. Tijdschr. 83:155–163.

Patton, M.Q. 2002. Qualtitative Research & Evaluation Methods. 3rd ed. Sage, Thousand Oaks, CA.

Paul, E.S., and J.A. Serpell. 1993. Childhood pet keeping and humane attitudes in young adulthood. Anim. Welf. 2:321–337.

De Paula Vieira, A., M.A.G. von Keyserlingk, and D.M. Weary. 2010. Effects of pair versus single housing on performance and behavior of dairy calves before and after weaning from milk. J. Dairy Sci. 93:3079–3085. doi:10.3168/jds.2009-2516.

Pearce, P.L. 1990. Farm tourism in New Zealand. A social situation analysis. Ann. Tour. Res. 17:337–352. doi:10.1016/0160-7383(90)90002-9.

Pelletier, D., and V. Kraak. 1998. How marketers reach young consumers : Implications for nutrition education and health promotion campaigns. Fam. Econ. Nutr. Rev. 11:31–41.

Pempek, J.A., M.L. Eastridge, and K.L. Proudfoot. 2017. The effect of a furnished individual hutch pre-weaning on calf behavior, response to novelty, and growth. J. Dairy Sci. 100:4807–4817. doi:10.3168/jds.2016-12180.

Phillips, C., S. Izmirli, J. Aldavood, M. Alonso, B. Choe, A. Hanlon, A. Handziska, G. Illmann, L. Keeling, M. Kennedy, G. Lee, V. Lund, C. Mejdell, V. Pelagic, and T. Rehn. 2011. An international comparison of female and male students' attitudes to the use of animals. Animals 1:7–26. doi:10.3390/ani1010007.

Pirog, R. 2004. Consumer Perceptions of Pasture-Raised Beef and Dairy Products: An Internet Consumer Study. Accessed May 18, 2019. https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1134&amp=&context=leopold_pubspapers&amp=&sei-redir=1&referer=https%253A%252F%252Fscholar.google.com%252Fscholar%253Fhl%253Den%2526as_sdt%253D0%25252C24%2526q%253DPirog%25252C%252BR.%252B2004.%252BCon.

Prickett, R.W. 2008. Consumer preferences for farm animal welfare: Results from a telephone survey of U.S. households.

Prokop, P., and S.D. Tunnicliffe. 2010. Effects of having pets at home on children's attitudes toward popular and unpopular animals. Anthrozoos 23:21–35.

doi:10.2752/175303710X12627079939107.

Rauch, A., and J. Sharp. 2005. Ohioans' attitudes about animal welfare. A topical report from the 2004 Ohio survey of food, agricultural and environmental issues. Columbus, OH.

Raussi, S., S. Niskanen, J. Siivonen, L. Hänninen, H. Hepola, L. Jauhiainen, and I. Veissier. 2010. The formation of preferential relationships at early age in cattle. Behav. Processes 84:726–731. doi:10.1016/j.beproc.2010.05.005.

Regmi, A., and M. Gehlhar. 2001. Consumer preferences and concerns shape global food trade. Food Rev. 24:2–8. doi:10.15353/cfs-rcea.v2i2.80.

Reiten, M., T. Rousing, P.T. Thomsen, and J.T. Sørensen. 2019. Short communication: Are group size and pasteurization of whole milk associated with diarrhea and growth of pre-weaned organic dairy calves?. Res. Vet. Sci. 123:32–34. doi:10.1016/j.rvsc.2018.11.021.

Robbins, J.A., B. Franks, D.M. Weary, and M.A.G. Von Keyserlingk. 2016. Awareness of ag-gag laws erodes trust in farmers and increases support for animal welfare regulations. Food Policy 61:121–125. doi:10.1016/j.foodpol.2016.02.008.

Robbins, J.A., D.M. Weary, C.A. Schuppli, and M.A.G. Von Keyserlingk. 2015. Stakeholder views on treating pain due to dehorning dairy calves. Anim. Welf. 24:399–406. doi:10.7120/09627286.24.4.399.

Roedder, D.L. 1981. Age differences in children's responses to television advertising: An information-processing approach. J. Consum. Res. 8:144. doi:10.1086/208850.

Rollin, B.R. 1993. Animal welfare, science, and value. J. Agric. Environ. Ethics 6:44–50.

Rudman, L.A. 2012. Sources of implicit attitudes sources of implicit attitudes. Psychol.

Sci. 13:79–82. doi:10.1111/j.0963-7214.2004.00279.x.

Sandelowski, M. 1995. Sample size in qualitative research. Res. Nurs. Health 18:179–183. doi:10.1002/nur.4770180211.

Sato, S., K. Tarumizu, and K. Hatae. 1993. The influence of social factors on allogrooming in cows. Appl. Anim. Behav. Sci. 38:235–244. doi:10.1016/0168-1591(93)90022-H.

Schwartz, S.H. 1999. A Theory of Cultural Values and Some Implications for Work. Appl. Psychol. 48:23–47. doi:10.1111/j.1464-0597.1999.tb00047.x.

Schweikhardt, D.B., and W.P. Browne. 2001. Politics by other means: The emergence of a new politics of food in the United States. Rev. Agric. Econ. 23:302–318. doi:10.1111/1467-9353.00063.

Serpell, J.A. 2005. Factors influencing veterinary students' career choices and attitudes to animals. J. Vet. Med. Educ. 32:491–496. doi:10.3138/jvme.32.4.491.

Sharma, A., and V. Sonwaney. 2014. Theoretical modeling of influence of children on family purchase decision making. Procedia - Soc. Behav. Sci. 133:38–46. doi:10.1016/j.sbspro.2014.04.167.

Spain, C., D. Freund, H. Mohan-Gibbons, R. Meadow, and L. Beacham. 2018. Are they buying it? United States consumers' changing attitudes toward more humanely raised meat, eggs, and dairy. Animals 8:128. doi:10.3390/ani8080128.

Spooner, J.M., C.A. Schuppli, and D. Fraser. 2014. Attitudes of Canadian citizens toward farm animal welfare: A qualitative study. Livest. Sci. 163:150–158. doi:10.1016/j.livsci.2014.02.011.

Story, M., and S. French. 2004. International journal of behavioral food advertising and

marketing directed at children and adolescents in the US. Int. J. Behav. Nutr. Phys. Act. 17:1–17. doi:10.1186/1479-5868-1-3.

Sumner, C.L., M.A.G. von Keyserlingk, and D.M. Weary. 2018. Perspectives of farmers and veterinarians concerning dairy cattle welfare. Anim. Front. 8:8–13. doi:10.1093/af/vfx006.

Thornton, P.K. 2010. Livestock production: recent trends, future prospects. Philos. Trans. R. Soc. B Biol. Sci. 365:2853–2867. doi:10.1098/rstb.2010.0134.

Tiplady, C.M., D.A.B. Walsh, and C.J.C. Phillips. 2013. Public response to media coverage of animal cruelty. J. Agric. Environ. Ethics 26:869–885. doi:10.1007/s10806-012-9412-0.

Tiplady, C.M., D.B. Walsh, and C.J.C. Phillips. 2012. Intimate partner violence and companion animal welfare. Aust. Vet. J. 90:48–53. doi:https://doi.org/10.1111/j.1751-0813.2011.00843.x.

Tonsor, G.T. 2018. Public animal welfare discussions in the United States: Perspectives from a Missouri farm boy turned economist. Anim. Front. 8:4–7. doi:10.1093/af/vfx002.

Tonsor, G.T., and N.J. Olynk. 2011. Impacts of animal well-being and welfare media on meat demand. J. Agric. Econ. 62:59–72. doi:https://doi.org/10.1111/j.1477-9552.2010.00266.x.

Tonsor, G.T., N.J. Olynk, and C.A. Wolf. 2009a. Media coverage of animal handling and welfare: influence on meat demand. Page 35 in AgEcon Search.

Tonsor, G.T., C. Wolf, and N. Olynk. 2009b. Consumer voting and demand behavior regarding swine gestation crates. Food Policy 34:492–498.

doi:10.1016/j.foodpol.2009.06.008.

Vanhonacker, F., E. Van Poucke, F. Tuyttens, and W. Verbeke. 2010. Citizens' views on farm animal welfare and related information provision: Exploratory insights from Flanders, Belgium. J. Agric. Environ. Ethics 23:551–569. doi:10.1007/s10806-010-9235-9.

Vanhonacker, F., and W. Verbeke. 2014. Public and consumer policies for higher welfare food products: Challenges and opportunities. J. Agric. Environ. Ethics 27:153–171. doi:10.1007/s10806-013-9479-2.

Vanhonacker, F., W. Verbeke, E. Van Poucke, and F.A.M. Tuyttens. 2007. Segmentation based on consumers' perceived importance and attitude toward farm animal weldare. Int. J. Sociol. Food Agric. 15:84–100.

Vanhonacker, F., W. Verbeke, E. Van Poucke, and F.A.M. Tuyttens. 2008. Do citizens and farmers interpret the concept of farm animal welfare differently?. Livest. Sci. 116:126–136. doi:10.1016/j.livsci.2007.09.017.

Vanuga, J. 2018. US farmers 'massively overusing' antibiotics. Vet. Rec. 182:278–279. doi:10.1136/vr.k1102.

Veissier, I., P. Chazal, P. Pradel, and P. Le Neindre. 1997. Providing social contacts and objects for nibbling moderates reactivity and oral behaviors in veal calves.. J. Anim. Sci. 75:356. doi:10.2527/1997.752356x.

Ventura, B., M.A.G. Von Keyserlingk, H. Wittman, and D.M. Weary. 2016. What difference does a visit make? Changes in animal welfare perceptions after interested citizens tour a dairy farm. PLoS One 11:1–18. doi:10.1371/journal.pone.0154733.

Ventura, B.A. 2015. Understanding industry and lay perspectives on dairy cattle welfare.

Ventura, B.A., and C. Croney. 2019. To meet the ethical imperative of telos in modern dairy production: Societal concern for naturalness, animal welfare, and opportunities for resolution through science. T. Engle, D.J. Klingborg, and B.E. Rollin, ed. CRC Press, Boca Raton, FL.

Ventura, B.A., M.A.G. von Keyserlingk, C.A. Schuppli, and D.M. Weary. 2013. Views on contentious practices in dairy farming: The case of early cow-calf separation. J. Dairy Sci. 96:6105–6116. doi:10.3168/jds.2012-6040.

Verbeke, W.I.M.A.J., and J. Viaene. 2000. Ethical Challenges for Livestock Production: Meeting cosnumer concerns about meat safety and animal welfare. J. Agric. Environ. Ethics 12:141–151.

Vermeir, I., and W. Verbeke. 2008. Sustainable food consumption among young adults in Belgium: Theory of planned behaviour and the role of confidence and values. Ecol. Econ. 64:542–553. doi:10.1016/j.ecolecon.2007.03.007.

Wallace, D.S., R.M. Paulson, C.G. Lord, and C.F. Bond. 2005. Which behaviors do attitudes predict? Meta-analyzing the effects of social pressure and perceived difficulty. Rev. Gen. Psychol. 9:214–227. doi:10.1037/1089-2680.9.3.214.

Waltner-Toews, D., S.W. Martin, and A.H. Meek. 1986. Dairy calf management, morbidity and mortality in Ontario Holstein herds. III. Association of management with morbidity. Prev. Vet. Med. 4:137–158. doi:10.1016/0167-5877(86)90019-X.

Ward, S. 1974. Consumer socialization. J. Consum. Res. 1:1. doi:10.1086/208584.

Warnick, V.D., C.W. Arave, and C.H. Mickelsen. 2010. Effects of group, individual, and isolated rearing of calves on weight gain and behavior. J. Dairy Sci. 60:947–953. doi:10.3168/jds.s0022-0302(77)83968-4.

Weary, D.M. 2018. Understanding and responding to public concerns regarding farm animal welfare. J. Anim. Sci. 96:5.

Weary, D.M., M.J. Hötzel, J.A. Robbins, C.S. Cardoso, and M.A.G. von Keyserlingk. 2015a. Imagining the ideal dairy farm. J. Dairy Sci. 99:1663–1671. doi:10.3168/jds.2015-9925.

Weary, D.M., B.A. Ventura, and M.A.G. von Keyserlingk. 2015b. Societal views and animal welfare science: understanding why the modified cage may fail and other stories. Animal 10:309–317. doi:10.1017/s1751731115001160.

Weible, D., K. Zander, I. Christoph-Schulz, and P. Salamon. 2014. Citizens' perception of modern pig production in Germany: a mixed-method research approach. Br. Food J. 118:2014–2032. doi:10.1108/BFJ-12-2015-0458.

Wood, M.T. 1977. Social grooming patterns in two herds of monozygotic twin dairy cows. Anim. Behav. 25:635–642. doi:10.1016/0003-3472(77)90114-2.

Wormsbecher, L., R. Bergeron, D. Haley, A.M. de Passillé, J. Rushen, and E. Vasseur. 2017. A method of outdoor housing dairy calves in pairs using individual calf hutches. J. Dairy Sci. 100:7493–7506. doi:10.3168/jds.2017-12559.

Yunes, M.C., M.A.G. Von Keyserlingk, and M.J. Hötzel. 2017. Brazilian citizens' opinions and attitudes about farm animal production systems. Animals 7:1–15. doi:10.3390/ani7100075.

APPENDIX I – Tables

Table 1. Description of participants who completed the youth survey (n = 463)

Variable	n
Gender	
Female	60.8%
Male	38.0%
I don't want to say	1.2%
Age	
5 years	2.8%
6 years	5.4%
7 years	7.6%
8 years	7.1%
9 years	12.3%
10 years	7.1%
11 years	8.4%
12 years	9.3%
13 years	9.5%
14 years	5.8%
15 years	8.4%
16 years	6.9%
17 years	9.3%
Do you live in the country or the city?	

City/suburbs	82.3%
Country side	17.7%
Have you ever worked with or handled farm animals?	
No	62.6%
Yes	36.7%
I don't want to say	0.6%
Have you visited a farm with animals?	
No	16.0%
Yes	83.2%
I don't want to say	0.9%
Do any of your loved ones work in the dairy industry or on a dairy farm?	
No	75.6%
Yes	15.6%
I don't want to say	8.9%
Have you ever had a pet?	
No	10.2%
Yes	89.6%
I don't want to say	0.2%
Have you visited the Moo Booth, Dairy Building, Cattle Barn, or CHS Miracle of birth center?	
No	23.8%
Yes	76.2%
Do you use Facebook, Twitter, Snap Chat, or Instagram?	

No	43.2%
Yes	56.8%
Do you enjoy eating/drinking products like milk, cheese, yogurt, butter, or ice-cream?	
No	5.6%
Yes	94.4%
Do you enjoy eating/drinking any of the following products: almond milk, soy milk, or other plant-based milks?	
No	52.9%
Yes	43.0%
I don’t want to say	4.1%

Table 2. Think about what a dairy calf needs to have a good life. How important do you think these things are?

	The right amount of food, water, shelter, and doctor care. (n = 463)	Ability to play with other calves. (n = 463)	Treated calmly and respectfully by owner. (n = 463)
Very important	86.8%	30.2%	83.4%
Important	12.1%	40.4%	14.5%
Moderately important	0.6%	19.0%	1.3%
Slightly important	0.4%	6.0%	0.4%
Not important	0.0%	4.3%	0.4%

Table 3. Housing Preference and Themes

Housing preference (n = 463)	Description of theme	Percent of respondents that preferred housing option
Individual (n = 26)[1]		
environmental quality	This theme referenced the housing setup with limited other details, made reference to food and/or water, organization or perceived safety of the housing.	38.5%
optics	This theme referenced the way the housing setup looked to them.	26.9%
individual health attention	This theme referenced how individual housing is an effective way for the producer to manage calves' health and nutrition on an individual basis.	19.2%
being alone	This theme referenced how being housed alone was preferred for calves because they have their own private space, away from other calves.	19.2%
miscellaneous	This theme referenced themes raised by participants that were not well-captured by the common reasons.	7.7%
Pair (n = 66)[1]		
socialization	This theme referenced the housing system as allowing play or interaction between calves, or calves needing a friend or companion.	31.8%
compromise between housing systems	This theme referenced aspects of socialization opportunities for the calves and manageability for the producer. Also, participants mentioned that this was the ideal size because group housing had too many calves and individual housing was too isolated.	28.8%
environmental quality	As described above	24.2%
affective state	This theme referenced promotion of positive feelings such as happiness and avoidance of negative feelings such as stress and loneliness.	19.7%
space allowance	This theme referenced that the space allowance was adequate for the calf/calves.	16.7%

optics	As described above	7.8%
miscellaneous	As described above	1.5%
Group (n = 371)[1]		
socialization	As described above	71.4%
space allowance	As described above	58.5%
environmental quality	As described above	11.6%
affective state	As described above	5.4%
optics	As described above	3.0%
miscellaneous	As described above	0.8%

[1] The sum does not equal 100% within each category as participants often referenced multiple themes.

Table 4. Description of participants who completed the adult survey (n = 1,310)

Variable	n
Gender	
Female	64.9%
Male	34.8%
Non-binary	0.3%
Age	
18-24	14.7%
25-34	14.8%
35-44	18.2%
45-54	22.0%
55-64	19.7%
65-74	8.9%
75 years or older	1.1%
Prefer not to answer	0.6%
What is the highest degree or level of school you have completed? If currently enrolled, highest degree received.	
High school graduate	17.8%
Vocational or apprenticeship degree	9.8%
Undergraduate degree	41.3%
Master's degree	19.8%
PhD	3.3%
Professional degree (e.g. DVM, MD, JD, RN)	6.1%
Prefer not to answer	1.8%
What is your total household income?	
Less than $10,000	4.2%
$10,000 - $19,999	2.4%
$20,000 - $29,999	4.1%
$30,000 - $39,999	6.5%
$40,000 - $49,999	6.6%
$50,000 - $59,999	5.5%
$60,000 - $69,999	5.5%
$70,000 - $79,999	6.9%
$80,000 - $89,999	6.1%
$90,000 - $99,999	5.8%
$100,000 - $149,999	20.2%
More than $150,000	17.9%
Prefer not to say	8.2%
Which best described where you have lived most of your life?	
Rural	18.5%
Urban	81.5%
Have you ever worked on a livestock farm?	
No	80.7%
Yes	19.1%

Prefer not to answer	0.2%
Have you ever been on a livestock farm?	
No	36.6%
Yes	62.9%
Prefer not to answer	0.5%
Do any of your loved ones work in the dairy industry or on a dairy farm?	
No	78.5%
Yes	21.5%
Have you ever had a pet?	
No	6.0%
Yes	94.0%
Have you visited the Moo Booth, Dairy Building, Cattle Barn, or CHS Miracle of birth center?	
No	10.8%
Yes	89.2%
Do you use Facebook, Twitter, Snap Chat, or Instagram?	
No	16.5%
Yes	83.5%
Do you consumer dairy products?	
No	6.3%
Yes	93.7%
Do you consume any of the following products: soy milk, almond milk, flaxseed milk, or other plant-based milks?	
No	47.1%
Yes	52.9%

Table 5. Think about what a dairy calf needs to have a good life. How important do you think these things are?

	The right amount of food, water, shelter, and doctor care. (n = 1,310)	Ability to play with other calves. (n = 1,310)	Treated calmly and respectfully by owner. (n = 1,310)
Very important	89.4%	55.6%	75.0%
Important	9.2%	29.8%	20.1%
Moderately important	1.1%	10.0%	4.2%
Slight important	0.2%	3.1%	0.5%
Not important	0.2%	1.5%	0.2%

Table 6. Housing acceptance and themes

Housing acceptance (n = 1,310)	Description of theme	**Percent of respondents that preferred housing option**
Individual housing – Strongly agree (n = 139); Agree (n = 273)[1]		
individual health attention	This theme referenced calves having individualized attention for treatment and nutrition, controlling for disease, and overall better health monitoring.	29.7%
environmental quality	This theme referenced housing characteristics with limited other detail, referenced food or water availability, or safety of the housing.	21.9%
lack of socialization	This theme referenced lack of socialization available due to housing system. Participants occasionally mentioned negative feelings of being alone.	20.3%
conditional acceptance	This theme referenced that the housing system was acceptable for a temporary amount of time.	12.5%
visual/auditory *interaction*	This theme referenced that this housing option was acceptable to them because the calf was near its peers and could visually see or hear other calves or participants mentioned this was acceptable because calves don't need physical contact.	12.5%
management	This theme referenced that this housing option allowed easier management for the producer or easier access to the calf.	6.3%
space allowance	This theme referenced that the space allowance was adequate for the calf/calves.	4.7%
Individual housing – Disagree (n = 442); Strongly Disagree (n = 174)[1]		

lack of socialization	As described above	71.6%
lack of space allowance	This theme referenced that the space allowance was inadequate for the calf/calves.	29.8%
unnaturalness	This theme referenced participants dissatisfaction with housing system because they felt it was unnatural, commonly mentioning the system was missing pasture and "mom". Also, this theme included referencing to the housing option being inhumane.	9.1%
conditional acceptance	As described above	3.8%
Pair housing – Strongly agree (n = 236); Agree (n = 628)[1]		
socialization	This theme referenced some description of play behavior or interaction between the calves and having a friend/calf/family member.	56.0%
compromise between housing systems	This theme referenced aspects of socialization opportunities for the calves and manageability for the producer.	15.6%
management concerns	This theme referenced concerns regarding disease control, farmer manageability, handler safety, calf safety, hygiene, humane handling, and resource availability.	14.9%
environmental quality	As described above	9.9%
space allowance	As described above	9.9%
conditional acceptance	As described above	3.5%

Pair housing – Disagree (n = 154); Strongly Disagree (n = 31)[1]		
lack of space allowance	As described above	69.6%
lack of socialization	As described above	27.5%
management concerns	As described above	11.6%
unnaturalness	As described above	11.6%
Group housing – Strongly agree (n = 384); Agree (n = 609)[1]		
socialization	As described above	50.8%
space allowance	As described above	32.8%
management concerns	As described above	17.5%
environmental quality	As described above	7.3%
previous experience	This theme referenced the housing option being acceptable due to previous experience housing calves in this system.	2.3%
conditional acceptance	As described above	1.1%
Group housing – Disagree (n = 82); Strongly Disagree (n = 15)[1]		
unnaturalness	As described above	52.9%
management concerns	As described above	32.4%

lack of space allowance	As described above	20.6%

[1] The percent does not equal n within each category as participation was optional.

Table 7. Demographic associations with acceptance of individual calf housing

Demographic	Row Percent	SE of Row Percent	*P*-value
Gender			< 0.0001
Male	38.8	2.3	
Female	27.6	1.5	
Residency			< 0.0001
Rural	43.0	3.2	
Urban	28.8	1.4	
Previous livestock experience			< 0.0001
Yes	49.2	3.2	
No	27.3	1.4	
Loved one who works in industry			< 0.0001
Yes	44.4	3.0	
No	27.9	1.4	
Previously visited cattle related Fair locations			0.0060
Yes	30.4	1.3	
No	40.1	4.1	
Social media platform usage			0.0034
Yes	29.6	1.4	
No	40.7	3.3	

Table 8. Demographic associations with acceptance of pair calf housing

Demographic	Row Percent	SE of Row Percent	*P*-value
Gender			0.0456
Male	68.9	2.2	
Female	64.5	1.6	
Previous livestock experience			0.0401
Yes	72.0	2.8	
No	64.4	1.5	
Previous experience visiting livestock farm			0.0161
Yes	68.8	1.6	
No	61.0	2.2	

APPENDIX II – Figures

Figure 1. Individual calf housing option.

Figure 2. Pair calf housing option.

Figure 3. Group calf housing option.

Figure 4. Calf housing preference among youth

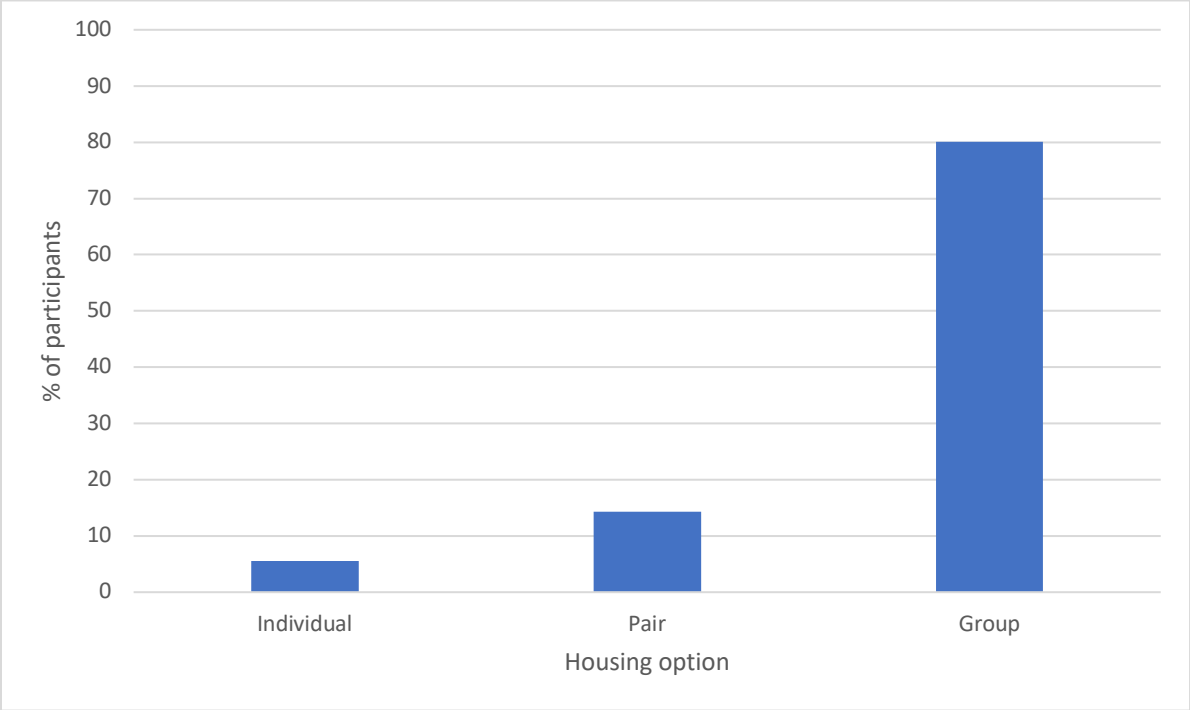
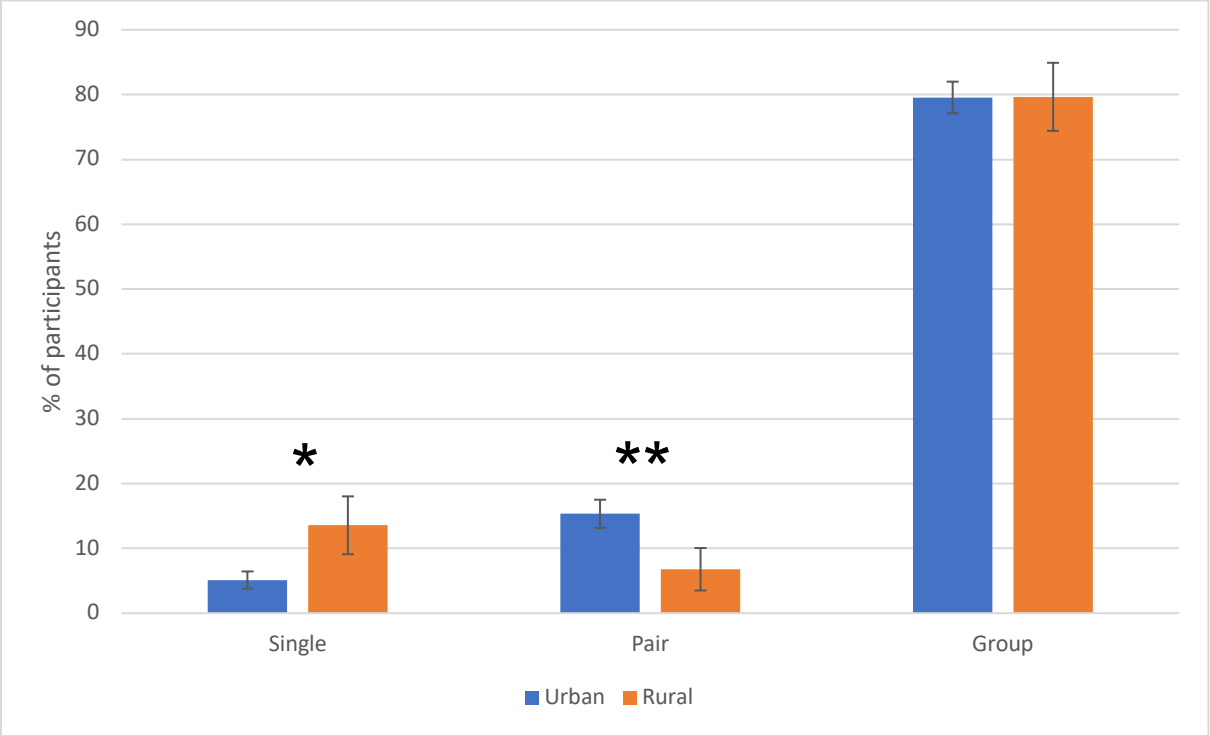


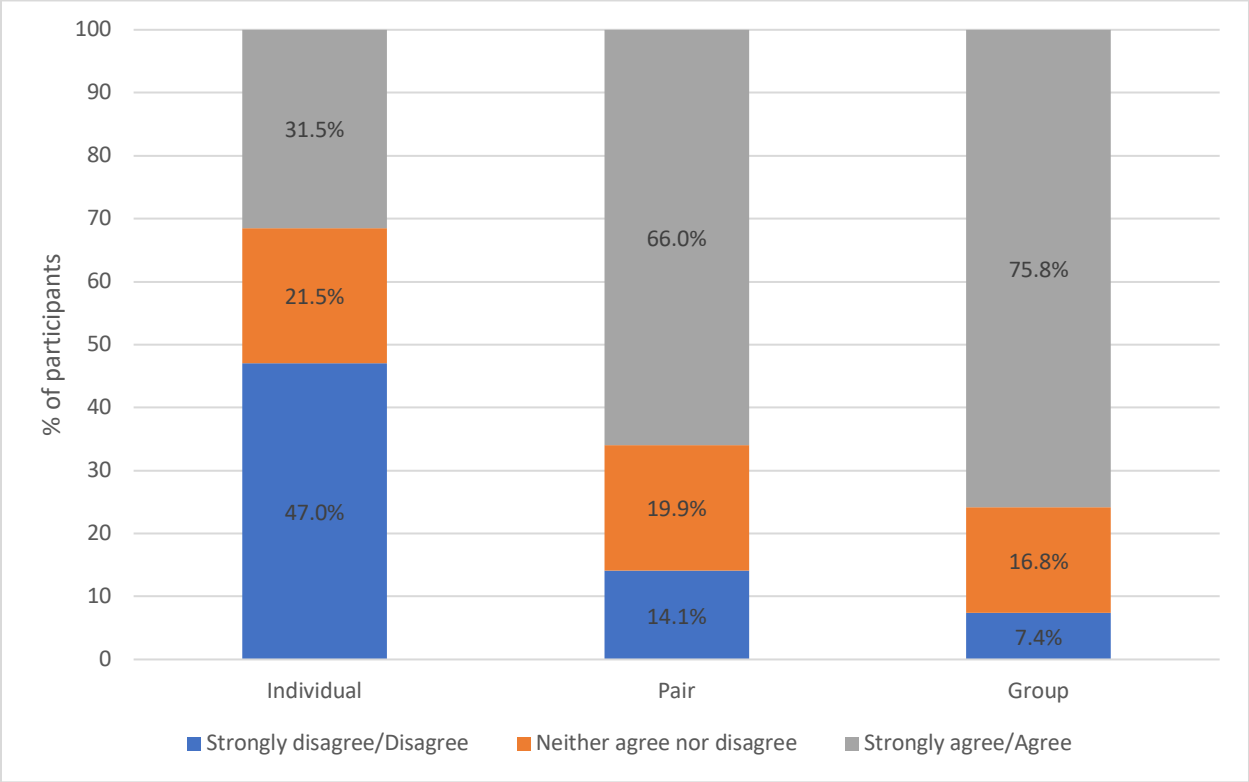
Figure 5. Calf housing preference of youth and their area of residency



* $p = 0.0258$

** $p = 0.0206$

Figure 6. Acceptance of individual, pair, and group dairy housing options in adults



APPENDIX III – Survey Instruments

YOUTH SURVEY

Welcome to the University of Minnesota Moo Matters! Survey.

Participant Number:

Q1. How old are you?

Q2. What is your gender?

☐ Girl

☐ Boy

☐ I don't want to say

Q3. Do you live in the country or the city?

☐ City/suburbs

☐ Country side

Q4. Have you ever worked with or handled farm animals? If yes, please tell us which type(s) of animals.

☐ Yes _____

☐ No

☐ I don't want to say

(Condition: Yes Is Selected. Skip to: Do any of your loved ones work in the dairy industry or on a dairy farm?)

Q5. Have you visited a farm with animals? If yes, please tell us which type(s) of animals were on the farm.

☐ Yes _____

☐ No

☐ I don’t want to say

Q6. Do any of your loved ones work in the dairy industry or on a dairy farm?

☐ Yes

☐ No

☐ I don’t know

Q7. Have you ever had a pet?

☐ Yes

☐ No

☐ I don’t want to say

Q8. Have you visited any of these locations at the Fair? Please check all that apply.

☐ Moo Booth (educational displays inside the cattle barn)

☐ CHS Miracle of Birth Center (where you can witness baby animals being born)

☐ Cattle Barn (where the live cattle are)

☐ Dairy Building (where the butter head sculptures are displayed)

☐ None

Q9. Do you use any of the following social media platforms?

☐ Facebook

☐ Twitter

☐ Instagram

☐ Snap Chat

☐ None

Q10. Do you enjoy eating/drinking dairy products like milk, cheese, yogurt, butter, or ice cream? If no, please tell us why.

☐ Yes

☐ No _____

Q11. Do you enjoy eating or drinking any of the following products: almond milk, soymilk, other plant-based milks?

☐ Yes

☐ No

☐ I don't want to say

Q12. In your opinion, what does a dairy calf need to have a good life?

Q13. Think about what a dairy calf needs to have a good life. How important do you think these things are?

The right amount food, water, shelter, and doctor care.

☐ Very important

☐ Important

☐ Moderately important

☐ Slightly important

☐ Not important

Ability to play with other calves.

☐ Very important

☐ Important

☐ Moderately important

☐ Slightly important

☐ Not important

Treated calmly and respectfully by owner.

☐ Very important

☐ Important

☐ Moderately important

☐ Slightly important

☐ Not important

Q14. Which calf house do you like best?

Q15. Why did you choose that picture?

ADULT SURVEY

Welcome to the University of Minnesota Moo Matters! Survey.

Participant Number:

Section A: General demographics

Q1. Gender:

☐ Female

☐ Male

☐ Non-binary/other

☐ Prefer not to say

Q2. Age:

☐ 18-24

☐ 25-34

☐ 35-44

☐ 45-54

☐ 55-64

☐ 65-74

☐ 75 years or older

☐ Prefer not to answer

Q3. What is the highest degree or lvel of school you have completed? If currently enrolled, highest degree received.

☐ High school graduate

☐ Vocational or apprenticeship degree

☐ Undergraduate degree

☐ Master's degree

☐ PhD

☐ Professional degree (e.g. DVM, MD, JD, RN)

☐ Other

☐ Prefer not to answer

Q4. What is your total household income?

☐ Less than $10,000

☐ $10,000 to $19,999

☐ $20,000 to $29,999

☐ $30,000 to $39,999

☐ $40,000 to $49,999

☐ $50,000 to $59,999

☐ $60,000 to $69,999

☐ $70,000 to $79,999

☐ $80,000 to $89,999

☐ $90,000 to $99,999

☐ $100,000 to $149,999

☐ More than $150,000

☐ Prefer not to say.

Q5. Which best describes where you have lived for most of your life?

☐ Urban

☐ Suburban

☐ Rural (not on a farm)

☐ Rural (on a farm)

Q6. Have you ever worked on a livestock farm? If yes, please indicate which type(s) of farms:

☐ Yes _____

☐ No

☐ Prefer not to answer

(Condition: Yes Is Selected. Skip To: Do any of your loved ones work in the dairy industry or on a dairy farm?)

Q7. Have you ever been on a livestock farm? If yes, please indicate which type(s) of farms:

☐ Yes _____

☐ No

☐ Prefer not to answer

Q8. Do any of your loved ones work in the dairy industry or on a dairy farm?

☐ Yes

☐ No

☐ I don’t know

Q9. Have you ever had a pet?

☐ Yes

☐ No

☐ I don’t want to say

Q10. Have you visited any of these locations at the Fair? Please check all that apply.

☐ Moo Booth (educational displays inside the cattle barn)

☐ CHS Miracle of Birth Center (where you can witness baby animals being born)

☐ Cattle Barn (where the live cattle are)

☐ Dairy Building (where the butter head sculptures are displayed)

☐ None

Q11. Do you use any of the following social media platforms?

☐ Facebook

☐ Twitter

☐ Instagram

☐ Snap Chat

☐ None

Q12. Do you consume dairy products? If no, please share why.

☐ Yes

☐ No _____

(Condition: No Is Selected. Skip To: Do you consumer any of the following products: soymilk, almond milk, flaxseed milk, or other plant-based milk?)

Q13. Do you consume organic dairy products?

☐ Always or almost always

☐ Often

☐ Sometimes

☐ Rarely

☐ Never or almost never

Q14. Do you consume any of the following products: soymilk, almond milk, flaxseed milk, or other plant-based milk? If no, please share why.

☐ Yes

☐ No _____

Think of the dairy calf, a calf unlike a human, starts walking within minutes after birth.

Q15. Consider the dairy calf: in your opinion, what do dairy calves need to have a good quality of life?

Q16. Consider the following aspects of dairy calf's life. Please let us know how important they are to you:

Adequate food, water, shelter, and veterinary care.

☐ Very important

☐ Important

☐ Moderately important

☐ Slightly important

☐ Not important

Opportunity to socialize (within a week after birth) and play with other calves.

☐ Very important

☐ Important

☐ Moderately important

☐ Slightly important

☐ Not important

Being treated calmly by caretaker to avoid causing fear and distress.

☐ Very important

☐ Important

☐ Moderately important

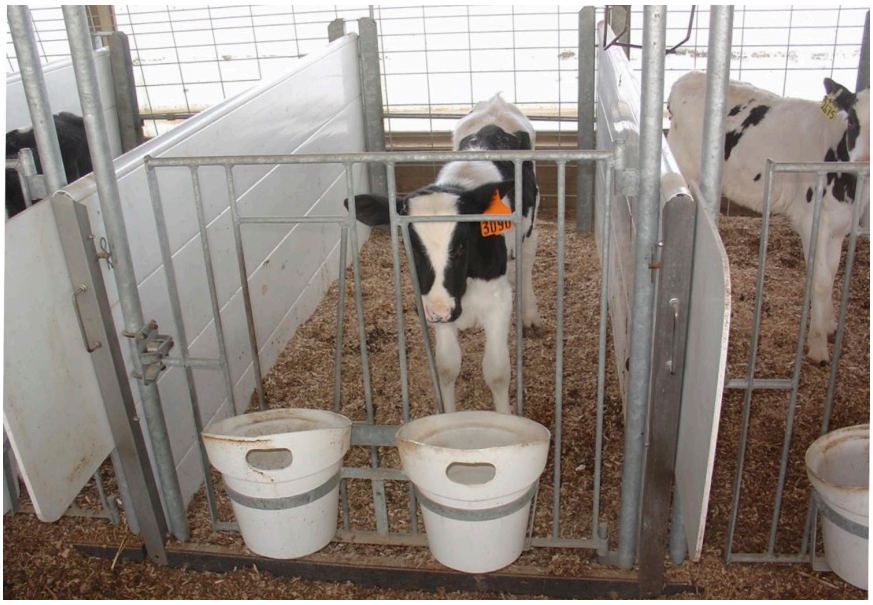
☐ Slightly important

☐ Not important

For the following question, Q17-Q19, we will show you three types of calf housing. The type of housing influences two aspects:

- Farmer's ability to manage calves' health and nutrition
- Calf's opportunity to socialize with other calves

Q17. These dairy calves are housed **individually**, which enables farmers to manage each calf's health and nutrition. Calves can see and hear other calves but have no physical contact.



Please indicate your agreement with the following statement: “This housing option is acceptable to me.” Feel free to explain your choice.

☐ Strongly agree _____

☐ Agree _____

☐ Neither agree nor disagree _____

☐ Disagree _____

☐ Strongly disagree _____

Q18. These dairy calves are housed **in pairs**, which could pose challenges for managing health and nutrition. Calves can freely socialize with each other.

Please indicate your agreement with the following statement: “This housing option is acceptable to me.” Feel free to explain your choice.

☐ Strongly agree _____

☐ Agree _____

☐ Neither agree nor disagree _____

☐ Disagree _____

☐ Strongly disagree _____

Q19. These dairy calves are housed in **small groups**, which could pose challenges for monitoring health. Calves can freely socialize with individuals in the group.

Please indicate your agreement with the following statement: “This housing option is acceptable to me.” Feel free to explain your choice.

☐ Strongly agree _____

☐ Agree _____

☐ Neither agree nor disagree _____

☐ Disagree _____

☐ Strongly disagree _____

Q20. Is there anything else you’d like the researchers to know?